Appendix A. Pre-Consultation Meeting Minutes

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Memorandum

Date: **May 2, 2016**

To: **Barbara Slattery and Craig Fowler (Ministry of Environment and Climate Change), Jennifer Dougherty and Tim Mereu (Credit Valley Conservation)**

From: **Deborah Sinclair, Tara Roumeliotis, Neil Hutchinson**

Cc: **Gary Scott and Joe Mullan (Ainley Group), Christine Furlong (Triton Engineering)**

Re: **J160005 – Town of Erin Class EA – Assimilative Capacity Study Update Work Plan**

This memorandum provides an outline of the assimilative capacity study (ACS) update work plan to be completed as part of Phases 1 and 2 of the Town of Erin Class EA.

1. Background and General Approach to Updating the ACS

The intent of the ACS completed as part of the Servicing and Settlement Master Plan (SSMP) was to assess the feasibility of a wastewater treatment facility (WWTF) with surface water discharge to the West Credit River in the reach between 10th Line and Winston Churchill. The preliminary ACS (by B.M. Ross and Associates) demonstrated this was viable; however recommended that the next phases of the EA should include a review of dissolved oxygen and temperature impacts, and potential for effluent storage. The Ontario Ministry of the Environment and Climate Change (MOECC) concurred (in a letter from Ms. Barbara Slattery dated October 31, 2015 to Ms. Furlong, Triton Engineering) that the original ACS be updated to include hydrodynamic modeling and additional stream flow information collected since the preliminary ACS was completed.

The SSMP identified a general area (along Wellington County Road 52, between 10th Line and Winston Churchill Boulevard) for the location of a wastewater treatment plant (WWTP). As part of the next phases of the EA, the ACS will be updated/refined and detailed modeling (mixing zone model and hydrodynamic far-field model) will be completed for three potential outfall locations. The models will be used to predict water temperature, dissolved oxygen, and nutrient loads in the receiver under a range of WWTP discharge scenarios (e.g. low flow, effluent storage and seasonal discharge). The flow rate and discharge criteria used for the modeling will be finalized in consultation with MOECC, Credit Valley Conservation (CVC) and the Town of Erin.

CORMIX will be used to complete the mixing zone modelling of the WWTP effluent and the West Credit River under a variety of flow scenarios. Oxygen and temperature modelling of the discharge in the River, as requested by the MOECC and CVC and recommended in the preliminary ACS, will be completed using the U.S. EPA's QUAL2K model. The QUAL2K model requires a large number of site-specific physical, chemical and biological information to accurately simulate the effect of the effluent on the receiver. The data to complete the modeling will be assembled from the background data and updated with current water quality, quantity and detailed field studies.

Completion of the ACS Update will occur in two-phases in order to provide the EA team (i.e., Town of Erin, Triton Engineering, Ainley Group) with a reasonable estimate of recommended WWTP effluent limits as soon as possible, as follows:

1) A draft ACS Update report will be completed by late spring/early summer. This report will include the updated 7Q20 and water quality data and use estimates in the modelling work where site specific data has not yet been collected. Draft WWTP effluent limits will be calculated and provided; and
2) A final ACS Update report will be completed in the fall. This report will incorporated the summer field investigations and an updated 7Q20 as modelling inputs and to complement the understanding of receiver water quality and quantity. Effluent limits will be finalized based on the site-specific information.

The following tasks will be completed as part of the full ACS update:

1. Review of preliminary ACS
2. Update to water quality and quantity statistics
3. Pre-consultation meeting with MOECC, CVC and the Town of Erin
4. Field investigations including survey of physical attributes of the West Credit River in the study area, water quality sampling, and a dye tracer study
5. Mixing zone modelling (CORMIX) and Far-field modelling (QUAL2K)
6. Derivation of WWTP effluent limits
7. Reporting and Presentations
8. Follow up meetings with MOECC, CVC and the Town of Erin

These tasks are detailed in the sections below.

2. Task 1 – Review Preliminary ACS

The Preliminary ACS completed by B.M. Ross and Associates (2014) will be reviewed to confirm the approach, water quality parameters modeled, 7Q20 derivation, model assumptions, modeling results, and proposed effluent limits.

3. Task 2 - Update Water Quality and Quantity Statistics

The preliminary ACS used water quality data from the Provincial Water Quality Monitoring Network (PWQMN) station located on the West Credit River at Winston Churchill Boulevard (PWQMN 06007601502) as input to the modeling work. This station is located in the study area and has a long-term record of water quality (1975-2015). We will update the monthly water quality summary statistics for this site to include the 2013 through 2015 data. Water quality parameters for the analysis will include 5-day biochemical oxygen demand (BOD_5), dissolved oxygen, Total Kjeldahl Nitrogen (TKN), total ammonia, un-ionized ammonia, nitrite, nitrate, total phosphorus, total suspended solids, pH, temperature, and *Escherichia coli*. Data will be assessed against the most current applicable Provincial Water Quality Objectives (PWQO; MOE 1994a) and Canadian Water Quality Guidelines (CWQG; CCME 2012) to confirm the policy status of the West Credit River at Winston Churchill Boulevard.

Effluent discharge to any receiver requires the determination that the receiver can effectively assimilate or dilute the effluent. In Ontario streams and rivers, the 7Q20 low-flow statistic is used as a basic design flow to determine the assimilative capacity of a stream or river. The 7Q20 flow represents the minimum 7-day average flow with a recurrence period of 20 years. This value determines the 5% chance of there not being adequate streamflow to properly dilute the point discharge.

A Water Survey of Canada (WSC) gauge located in the West Credit River 8^{th} Line provides a long-term (1983 - present) record of flow. Due to differences in geological conditions between the catchment area of this station and the WWTP study area (i.e., West Credit River between 10^{th} Line and Winston Churchill Boulevard), flows could not be pro-rated for the preliminary ACS (BM Ross 2014). Rather, a new gauging station was established at 10^{th} Line in 2013 to develop a flow transposition factor between the 8^{th} Line and the 10^{th} Line. The 7Q20 flows for 10^{th} Line were determined using this factor. CVC have recalculated the transposition factor using the most recent flow data from 8^{th} Line and 10^{th} Line (e.g. 2013 - 2015), and derived updated monthly 7Q20 statistics for 10^{th} Line. CVC will provide this updated 7Q20 data to Hutchinson Environmental Sciences Ltd. (HESL) in spring 2016 for review and use in the draft ACS update. (This 7Q20 will also be reviewed by Blackport Hydrogeology Inc. and the MOECC). CVC will provide a second updated 7Q20 to HESL in fall 2016 (after the low flow period) for use in the final ACS update. The final updated 7Q20 flow statistic should consider the effects on climate change on low flows.

4. Task 3 – Pre-consultation Meeting with MOECC, CVC and the Town

It has been our experience that early and frequent consultation with regulatory agencies encourages successful approval of ACSs by providing agencies the opportunity to review HESL's approach in advance so that refinements can be made. We propose to schedule a pre-consultation meeting after CVC and MOECC have had an opportunity to review this work plan. The purpose of the meeting will be to discuss any questions or concerns with the proposed work plan (including modeling approach, field investigations, and analyses) to ensure that all aspects of the study are adequately addressed.

5. Task 4 – Field Investigations

CVC completed an extensive Existing Condition Report (CVC 2011) as part of the SSMP, which summarized the existing hydrogeology, hydrology, geomorphology, aquatic ecology (fish and benthos), water quality, and hydraulics in the study area. Much of the information used for the preliminary ACS was collected from this report, as it provides an excellent baseline of the natural environment in the study area.

The updated ACS will draw on information contained in CVC's report, and update it with new information collected as part of the next phases of the EA. In particular, water quality and quantity, aquatic ecology (fish and benthos), terrestrial, and geomorphological investigations and inventories will be used to as inputs to the ACS and/or as part of the impact assessment.

The additional investigations required as part of the ACS as input into the models are described below.

5.1 Physical Attributes

The QUAL2K model requires a spatial segmentation of the receiving stream into a series of constant hydrogeometric characteristics, (i.e. depth, cross sectional area, average velocity and average flow). A good understanding of the physical environment is therefore necessary prior to undertaking the modeling exercise. A comprehensive stream assessment of West Credit River will be undertaken by fluvial geomorphologists and aquatic scientists. The primary objective of the investigation is to define and characterize distinct reaches in the West Credit River (within the study area, between 10th Line and Winston Churchill Boulevard) for input into the hydrodynamic model.

Specific reaches will be defined by their characteristic channel pattern, gradient, dimensions, bed material, and bank composition, as well as riparian and aquatic vegetation and in-stream obstructions (e.g., large woody debris). Developing a detailed image of the study area, both within the mixing zone (near-field) and beyond the point of complete mixing of the effluent and River (far-field), is important to provide a better understanding of the receiving environment and other potential influences on water quality and the assimilation process.

5.2 Water Quality

To simulate downstream water quality, the QUAL2K model requires 5-day and ultimate carbonaceous biochemical oxygen demand ($CBOD_5$ and $CBOD_u$), dissolved oxygen (DO), total phosphorus (TP), orthophosphate, inorganic phosphorus, organic phosphorus, Total Kjeldahl nitrogen (TKN), nitrate (NO_3), nitrite (NO_2), total ammonia, total suspended solids (TSS), chlorophyll *a*, and volatile suspended solids (VSS) concentrations. The relationships and reactions between these variables are used by the model to predict far-field water quality. Monthly water quality sampling in the West Credit River at Winston Churchill Boulevard during low flow conditions (May to September) for these parameters will be undertaken to provide a baseline upon which to use for the model. Some of these parameters (i.e., CBODu, orthophosphate, inorganic phosphorus, organic phosphorus, chlorophyll *a* and VSS) are not routinely collected under the PWQMN program and are required for the QUAL2K model. Therefore, the water quality sampling proposed will build a small dataset with which to use for the modelling.

Diurnal oxygen (DO) surveys will be conducted in the West Credit River during summer low-flow conditions (June through September) to determine baseline oxygen conditions in the river, and determine if oxygen is a limiting factor at night when photosynthesis is low and respiration is high. Optical dissolved oxygen probes (HOBO brand) will be deployed at three locations in the West Credit River between 10th Line and Winston Churchill Boulevard. The probes will measure dissolved oxygen and temperature, which will be used as input into the QUAL2K model, and to assess aquatic habitat conditions in the West Credit River at several different locations.

5.3 Dye Study

A dye study under low flow summer conditions will be conducted in the West Credit River to calculate time of travel and longitudinal dispersion, an input requirement into the QUAL2K model. A slug injection test, where a known amount of tracer is instantaneously injected into the river, will be completed at the preferred discharge location. Fluorometers (YSI 600 OMS instruments equipped with Rhodamine WT optical sensors) will be placed in the river at three locations downstream of the proposed discharge location. Rhodamine WT dye, a fluorescent pink xanthene dye, will be used as the tracer for the study. Rhodamine WT dye is a stable, non-toxic, and chemically unreactive dye that is easily measured in the field. The substance is non-carcinogenic, and is safe if it comes into contact with skin. Results of the dye study (i.e., time of travel and dispersion) will be used an input variables into the QUAL2K model.

6. Task 5 – Modeling

6.1 CORMIX

CORMIX is a mixing zone model developed by Cornell University for the analysis, prediction, and design of aqueous pollutant discharges into diverse water bodies. The model simulates the hydrodynamic behaviour of the effluent discharge and calculates the plume trajectory, dilution and maximum centerline concentration in the river. CORMIX will be used to predict water quality up to and including the point of complete mixing between the WWTP effluent and West Credit River.

The CORMIX model will be created with the measurements collected during the field investigations and all available water quality data (i.e., PWQMN and CVC). The CORMIX model will examine total ammonia nitrogen (with un-ionized ammonia concentrations calculated from field pH and temperature) and TP in order to determine concentrations of these parameters between the outfall and the point of complete mixing. The MOECC and CVC will be consulted to determine if any additional parameters should be modelled within the mixing zone. A mixing zone model will be built for three candidate outfall sites. Various outfall configurations (i.e., co-flowing, protruding, etc.) will be modelled to determine the configuration which results in optimal mixing.

6.2 QUAL2K

QUAL2K is a one-dimensional (1-D) river and stream water quality model, supported by the United States Environmental Protection Agency (US EPA), which is typically used to assess the environmental impact of discharges along rivers. A wide range of water quality parameters and chemical and biological pollutants can be modeled, including temperature, pH, DO (including the sag point location), CBOD, nitrogen species, phosphorus species, and suspended solids. QUAL2K assumes instantaneous complete mixing and as such, will be used to predict water quality in the West Credit River beyond the point of complete mixing (i.e., far-field water quality).

The QUAL2K model will be created with the measurements and water quality data collected from the PWQMN Station, CVC monitoring data, and field investigations outlined above. Similar to the CORMIX modelling, the QUAL2K model will be built and run for three different discharge locations on the West Credit River and under a variety of river flows, including the 7Q20 flow.

7. Task 6 – Derivation of WWTP Effluent Limits

The Ontario Ministry of the Environment and Climate Change (MOECC) have three documents that direct the discharge requirements for waste water treatment plants (WWTP). In *Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy* (MOE 1994a) the MOE provides direction on the management of surface water and groundwater quality and quantity for the Province of Ontario. In *Deriving Receiving Water Based, Point-Source Effluent Requirements for Ontario Waters* (MOE 1994b), the MOE provides guidance with regard to the requirements for point-source discharges and the procedures for determining effluent requirements for an Environmental Compliance Approval (ECA). In the Guideline F-5 Series *Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters* (MOE 1994c), the levels of treatment required are described, along with guidance on deriving effluent limits (concentrations and loading).

For the Erin WWTP, effluent limits will be derived from the results of the ACS, and the loading limits will be based on these effluent limits and the design average daily flow for the plant. The MOECC have recommended that best available treatment technology economically achievable (BATEA) be used in the WWTP design. The effluent limits will be cross-referenced with BATEA levels of treatment to determine the feasibility of the recommended effluent limits before they are proposed. The recommended WWTP effluent limits will be verified in writing with the MOECC, CVC and the Town.

8. Task 7 – Reporting and Presentations

A draft ACS Update report will be completed by late spring/early summer. Draft WWTP effluent limits will be provided in this report. A final ACS Update report will be completed in the fall and will include finalized effluent limits based on the site-specific information collected in summer 2016.

A Public Information Centre (PIC) will also be held in conjunction with the completed ACS update report.

9. Task 8 – Follow up Meetings with MOECC, CVC and the Town

A meeting with MOECC, CVC and the Town of Erin will be held after the final effluent limits are calculated and prior to submission of the final ACS Update report in order to discuss agency comments and/or questions regarding the limits. Additional meetings with MOECC, CVC and the Town of Erin will be held as required.

10. Schedule

The tasks to complete the ACS Update are scheduled as follows (Table 1).

Table 1. Schedule for ACS Update, Town of Erin Class EA

Task	Start	End
Review Preliminary Assimilation Capacity Study	1-Apr-16	15-Apr-16
Collect and review CVC 7Q20 and PWQMN data	12-Apr-16	25-Apr-16
Meeting with MOECC and CVC re: work plan	25-Apr-16	29-Apr-16
Derivation of preliminary effluent limits (modeling)	29-Apr-16	12-May-16
Draft Effluent Objectives and Limits	13-May-16	18-May-16
Draft ACS Update report	19-May-16	29-May-16
Field investigations for model inputs and calibration	1-May-16	30-Sep-16
Update ACS model with field data, update draft report	1-Oct-16	31-Oct-16
Meeting with MOECC and CVC re: effluent limits	1-Nov-16	16-Nov-16
Final Reporting – ACS Update	16-Nov-16	1-Dec-16

11. References

BM Ross. 2014. West Credit River Assimilative Capacity Study. File No. 08128. 124 pgs.

Canadian Council of Ministers of the Environment. 2012. Canadian water quality guidelines for the protection of aquatic life: Nitrate. In: Canadian environmental quality guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Credit Valley Conservation, Aquafor Beech Inc., and Blackport Hydrogeology Inc. 2011. Erin Servicing and Settlement Master Plan Phase 1 – Environmental Component – Existing Conditions Report.

Ontario Ministry of Environment and Energy. 1994a. Water management policies guidelines and water quality objectives of the Ministry of Environment and Energy, July 1994. ISBN 0-7778-8473-9 rev.

Ontario Ministry of the Environment (MOE). 1994b. Deriving receiving water based point source effluent requirements for Ontario waters. PIBS#3302 Procedure B-1-5.

Ontario Ministry of the Environment (MOE). 1994c. *Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters;* Guideline F-5 Series

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Meeting Minutes

Date: **May 30, 2016**

Location: **MOECC, 1 Stone Road, 3rd Floor, Room 305, Guelph**

Re: **J160005 – Erin Class EA – Assimilative Capacity Study Pre-Consultation Meeting**

Present:

Barbara Slattery (MOECC)
Craig Fowler (MOECC)
Manpreet Dhesi (MOECC)
Jennifer Dougherty (CVC)
Liam Murray (CVC)
John Sinnige (CVC)
Christine Furlong (Triton)
Ray Blackport (Blackport)
Gary Scott (Ainley)
Deborah Sinclair (HESL)
Neil Hutchinson (HESL)
Tara Roumeliotis (HESL)

Regrets: **Tim Mereu (CVC), Joe Mullan (Ainley)**

The purpose of the meeting was to review the ACS work plan with stakeholders and discuss any questions or concerns with the proposed approach (modelling, field investigations and analyses).

AGENDA

1. Introductions
2. Background
3. Review ACS work plan and tasks
4. Feedback and agreement on approach
5. Schedule and meetings
6. Additional items

ACTION ITEMS

Item	Description	Action
1	Check the *Erin Servicing and Settlement Master Plan; Phase 1 – Environmental Component – Existing Conditions Report* ("Existing Conditions" report), May 2011, for raw data needed.	HESL
2	Provide HESL with raw water quality data for 10th Line and Winston Churchill Blvd. that was used in the BM Ross preliminary ACS. Provide HESL with any additional water quality data acquired since that report (i.e., 2013 and onward)	CVC (Jennifer Dougherty)
3	Provide group with updated 7Q20 memorandum within approximately 2 weeks.	CVC (John Sinnige)
4	Confirm wastewater effluent flow for ACS - expected by end of summer	Ainley (Gary Scott)
5	• Measure flows at Winston Churchill and 10th Line during water quality sampling events for comparison • Evaluate need for to add chloride analyses to future water quality sampling events • Evaluate need to deploy pH logger in Credit River for diurnal pH cycle.	HESL

DISCUSSION NOTES

- Regarding additional data for the 10th Line (at West Credit River) station – CVC reported that there was no new water quality data for this station in 2013 through 2015. Only new water quality data is for the PQWMN station at Winston Churchill Blvd.
- CVC reported that they have a temperature gauge at 10th Line and at Winston Churchill Blvd.
- Septic Impact chapter in the *Erin Servicing and Settlement Master Plan; Phase 1 – Environmental Component – Existing Conditions Report* ("Existing Conditions" report), May 2011 provides flows measured by CVC at 10th Line and Winston Churchill Blvd. HESL to review report for raw flow data.
- Jennifer Dougherty (CVC) will provide HESL with any other raw data that BM Ross used in their preliminary ACS and that is not provided in the Existing Conditions report.
- John Sinnige provided an update on the 7Q20 calculation:
    - The rating curve for the 10th Line flow station is continually updated.

  - CVC are using the 8th Line gauge as well as transposing the 10th Line data with the Belfountain WSC station, which has about 15 years' worth of data.
  - The two gauges will give a lot more comfort in the 10th Line 7Q20.
  - CVC are currently in the process of revising the extrapolation.
  - Currently looking like the 7Q20 will remain the same or go up slightly.
  - CVC hope to have the 7Q20 memorandum ready for peer review in two weeks and will email this out to the group. Ray Blackport to provide review. MOECC may potentially comment.
- HESL asked if anyone had completed water quantity measurements at 10th Line and Winston Churchill in order to better understand the rates of groundwater discharge to the West Credit River within this reach. Ray Blackport reported collecting some spot flow measurements at both 10th Line and Winston Churchill.
- HESL recommended that water quality be modelled at 10th Line, since this will be a more conservative location than Winston Churchill Blvd (which has higher flows due to groundwater inputs and has been shown to have better water quality).
- Craig Fowler asked if HESL intended to start the ACS process over. HESL responded that the intention was to build on the preliminary ACS work completed by BM Ross.
- Craig Fowler inquired about the wastewater flow predictions in the BM Ross preliminary ACS of 435 L/person/day, including I/I.
  - Christine Furlong explained that BM Ross looked at water taking records to estimate wastewater flows; that 435 L/person/day is a conservative estimate. Also noted that 450 L/person/day is the MOECC maximum recommended design wastewater flow.
  - HESL asked Gary Scott to confirm the wastewater effluent flow that should be used in the ACS.
  - Gary Scott noted that the starting point for deriving the effluent flow is 2,610 m^3/d for 6,000 people, and that it will be an iterative process.
  - MOECC requested that the ACS is not submitted for review until the final effluent flows are confirmed.
  - CVC requested to Ainley to be a part of the discussion on population serviced, who will remain on septic, etc.
  - Town of Erin would like some growth in Hillsburgh on partial services – on municipal water and private septic.
- HESL raised question as to whether modelling seasonal discharge at proposed WWTP was still desired. Christine Furlong clarified that seasonal discharge was recommended for consideration during the SSMP and therefore it needed to be included in the ACS.
- CVC suggested that HESL complete diurnal pH monitoring in West Credit River, in addition to the DO and temperature monitoring that is already planned.
  - CVC noted that they had completed continuous pH monitoring in West Credit River, which may be presented in the Existing Conditions report. If not, HESL will request this data from CVC, and assess need to deploy pH logger
- HESL noted that dye tracer study will be conducted at 10th Line. Group requested that HESL also conduct the dye tracer study at Winston Churchill station and HESL agreed.

- In preparation for the dye tracer study, agencies and media will be notified. HESL will prepare a media release, which will be provided to Ainley and Triton for distribution. HESL to let Craig Fowler know when dye tracer study will take place.

- CVC suggested that chloride be added as a parameter of interest to the ACS modelling exercises.
  - HESL to review need to analyse water samples collected at 10th Line for chloride analysis
- HESL noted that there is not much value in completing the ACS for three discharge locations since results will not vary significantly. CORMIX modelling will be completed for a 10th Line discharge, as the most conservative location. If future discharge location recommendations change, the CORMIX modelling can be re-run easily.
- HESL noted that the Orangeville WWTP (which discharges to the Credit River) includes denitrification of wastewater and has a TN limit of 15 mg/L.
- Group approved the ACS work plan put forward by HESL, with the following comments:
  - The MOECC recommended against any radical changes in the ACS from what BM Ross has completed. The MOECC had approved in principal what BM Ross had put forward in the preliminary ACS. West Credit River is a Policy 1 receiver.
  - CVC supports the proposed diurnal DO studies.
- Ainley noted that the first PIC meeting is scheduled for mid-November and will cover the following items:
  - Service area
  - Type of collection system
  - Population numbers
  - Discharge and plant location (3 options)
- MOECC noted that they would prefer to not be involved in the whole ACS process, but would rather just review the finalized ACS report.
- With respect to the draft effluent limits, to be recommended in the draft ACS, MOECC requested that they be sent a copy of these for possible comment, but do not necessarily need to come to a meeting on the limits.
  - MOECC noted that they do not need to peer review the 7Q20 if the number was calculated based on sound science and peer-reviewed by Ray Blackport.
- CVC raised a concern regarding the potential cumulative effects of septic system discharge to the watershed from the planned partial servicing at Hillsburgh. CVC noted that the Hillsburgh reach of the West Credit River is very small with elevated nitrate concentrations. Discussion included:
  - the observation that the net effect of the EA was to remove septic systems from the watershed by servicing the Town of Erin
  - the suggestion was that any septic servicing at Hillsburgh would require state of the art tertiary treatment and that developers would be informed of this.
- CVC requested a separate meeting to discuss/address cumulative impact of new septic systems within Erin and Hillsburgh since it was identified in the meeting that it was outside the scope of the current EA.
- Liam Murray asked the group if it would be an issue to the ACS predictions if the Erin and Hillsburgh ponds are taken offline. HESL responded that water quality would be expected to improve if the ponds were taken offline.

- Liam Murray noted that there is a new gravel pit in Peel, near Winston Churchill Blvd. To the group's knowledge, there are no water taking operations occurring at the new gravel pit.
- Christine Furlong noted that that next project meeting should include the CORE Management Team.
- The meeting was adjourned at 1215 PM.

Appendix B. Update of Low Flow Assessment (7Q20) for the West Credit River Assimilative Capacity Study - CVC 2016

Watershed Management

To:	John Sinnige, Sr. Manager, Water Resources and Flood Risk	Date:	June 13, 2016
From:	Alex Pluchik, Hydrologist	Subject:	Update of Low Flow Assessment ($7Q_{20}$) for the West Credit River Assimilative Capacity Study (Erin SSMP)
Cc:	Neelam Gupta, Manager, Hydrology and Hydraulics	Our File:	Erin SSMP - ACS
Cc:	Jennifer Dougherty, Manager, Water Quality Protection		

Introduction

This memo summarizes the revision of $7Q_{20}$ values for the West Credit River at 10th line to support the update of the West Credit River assimilative capacity study. The initial assessment was completed at the end of 2013 in support of the Town of Erin Servicing and Settlement Master Plan (SSMP) study and was based on stream flows for the period from July to October 2013 at 10th Line. A similar approach was used to update the $7Q_{20}$ values based on stream flows for the period from July 2013 to end of 2015 (refer to Memo from March 14, 2016). The present memo finalizes the results of $7Q_{20}$ value assessment for the West Credit River at 10th line.

The location of the streamflow stations and proposed location of the WWTP effluent discharge are shown in Figure 1.

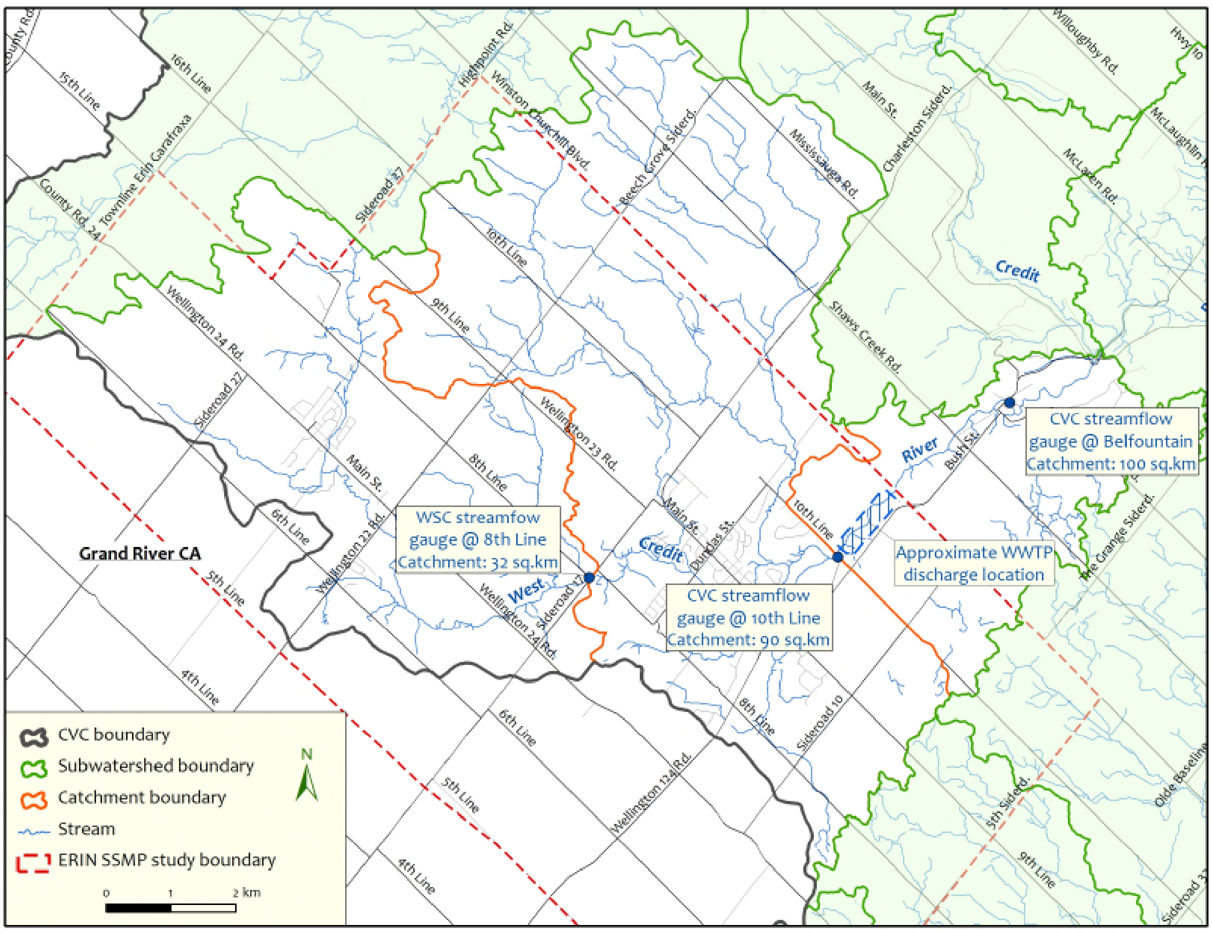


Figure 1: West Credit River watershed relative to the Assimilative Capacity Study limits for the Erin SSMP

Low Flow Analysis

The following methodology was applied to update the $7Q_{20}$ values for the West Credit River at 10^{th} line:

1. Mean daily flow series of the West Credit River at 8^{th} Line (WSC gauge, 1984-2015) were converted to the 7-day mean flows (7-day moving average).
2. Lowest 7-day mean flows for each year of record were collected for the Water Year (October 1-September 30), Summer (July-September), Fall-Winter-Spring (October-June) and for each month of year.
3. Mean daily flow series of the West Credit River at Belfountain (CVC gauge, 2002-2015) were converted to the 7-day mean flows (7-day moving average).
4. Lowest 7-day mean flows for each year of record were collected for the Water Year (October 1-September 30) and Summer (July-September).
5. The CVC real-time streamflow gauge at 10^{th} Line became active and fully operational at the end of July 2013. The development of a rating curve started at the same time. Since then, CVC field staff has measured 20 discharges (16 of them were used for the building of rating curve). The lowest discharges were measured at the end of July 2015; however the 2015 low flows were significantly higher than the low flows of summers 1995-2003 (excepting 1997), 2007 and 2012.

   Continuous water level data (15-min intervals) were converted to a continuous flow record using a rating curve fit equation (Shifted Power Law) developed in the WISKI module SKED (refer to Appendix, Figure A.1).

6. Mean daily and 7-day mean (moving average) flow series for the West Credit River at 10^{th} Line were produced using TSM module of WISKI. 7-day mean flows at the 8^{th} Line (WSC gauge) were paired with corresponding flows at the 10^{th} Line (CVC gauge) for the period of July 2013 – November 2015. These series were sorted by the ratio of 10^{th} Line flows to 8^{th} Line flows in ascending order. To remove outliers, values that lie outside of a band around the mean with a width of two standard deviations were not included for drawing the scatter graph and performing the regression analysis (refer to Appendix A, Figure A.2).
7. Similarly, 7-day mean flows at the Belfountain CVC gauge were paired with corresponding flows at the 10^{th} Line (CVC gauge) for the period of July 2013 – November 2015. These series were sorted by the ratio of Belfountain flows to 10^{th} Line flows in ascending order. Data that was obviously affected by freezing of the CVC Belfountain station were removed. Then values that lie outside of a band around the mean with a width of two standard deviations were not included for drawing the scatter graph and performing the regression analysis (refer to Appendix A, Figure A.3).
8. A regression analysis was executed to explore the relationships between streamflows at 8^{th} Line and 10^{th} Line and also Belfountain and 10^{th} Line. A linear trendline forced to intercept at nil was chosen as the best fit to observed data for both relations (refer to Appendix A, Figures A.2 and A.3). The quality of the regression equations was examined using the following indices: standard deviation of the criterion variable and standard error of estimate, coefficient of determination and F-test. Both regressions were deemed to be significant

given that the computed F-test is greater than F value extracted from the F values distribution table (level of significance = 0.05).

9. The low-flow frequency analysis was performed using the “Low Flow Frequency Analysis Package – LFA” (Environment Canada, September 1988). The program methodology is based on the Gumbel III distribution. This distribution has been recommended by Environment Canada as the best fit for extreme value analysis of low flows in the streams of South Ontario (Condie, Cheng, "Low Flow Frequency Analysis”, 1987). Also, the LFA application includes the Cunnane plotting-position formula for estimation the empirical exceedance probability.

10. The low-flow frequency analysis of the West Credit River at 8th Line data was performed for two data sets: 1984-2015 and 2002-2015. Also, the 7-day minimum flows of the West Credit River at Belfountain were processed for period of 2002-2015. The results of calculations ($7Q_{20}$ values) are presented in the Table 1 below and in the Appendix A, Table A.1 and Figures A.4, A.5 and A.6 (Gumbel III and Cunnane frequency curves).

Table 1: $7Q_{20}$ stream flows for the West Credit River gauges of WSC and CVC

(Water Year: Oct 1-Sep 30)

Station location/name	Data Set Period	$7Q_{20}$ (m^3/sec)	$7Q_{20}$ Ratio for 8thLine
8th Line (WSC)	1984-2015	0.123	
8th Line (WSC)	2002-2015	0.172	1.4
Belfountain (CVC)	2002-2015	0.428	

The significant difference between the $7Q_{20}$ values at 8th Line for the different periods (almost 40%) can be explained by the length of analysed data sets. The driest year of the 2002-2015 data set (2003) is positioned at 7th place in 1984-2015 data set, i.e. the 6 years with smallest 7-day minimum flows observed at the 8th Line gauge (flow record from 1981 to 2015) were not measured in the Belfountain gauge (flow record from 2002 to 2015).

11. $7Q_{20}$ values for the West Credit River at 10th Line were computed for period of 2002-2015 using described above two regression equations (one - based on 8th Line data set, second - based on Belfountain gauge data) and are presented in the Table 2 below.

Table 2: 7Q20 stream flows of the West Credit River at 10th line (2002-2015)

Station	$7Q_{20}$ by LFA (m^3/sec)	$7Q_{20}$ at 10th Line by Regression Equation (m^3/sec)	Difference (%)
8th Line (WSC)	0.172	0.350	2.8
Belfountain (CVC)	0.428	0.360	

Comparison of results, which are very close (difference is less than 3%), verifies accuracy of methodology used to calculate streamflow at 10th Line.

12. $7Q_{20}$ values for the West Credit River at 10^{th} Line were computed using the results of the low-flow frequency analysis of 8^{th} Line data for period 1984-2015 and described above regression equation between streamflows at 8^{th} Line and 10^{th} Line (refer to Appendix A, Table A.1). Using this time period, a water year $7Q_{20}$ of 0.250 m^3/sec was calculated, which is very similar to the water year $7Q_{20}$ of 0.246 m^3/sec calculated in the March 2016 memo.

Review of Results

1. A slight increase was found between the $7Q_{20}$ values for the West Credit River at 10^{th} Line computed for Water Year, Summer Season and September and provided in present and previous memos: 1.9%, 5.2% and 5.5 % respectively (refer to Appendix A, Table A.1). However, for the rest of year the $7Q_{20}$ increase is varying from 10% (August and Fall-Winter-Spring Season) to 19% (November, December and May). This increase can be clarified by using more statistically valid approach of selecting data for performing the regression analysis (refer to paragraphs 6 and 7). It allowed developing new linear regression equation between 7-day streamflows at 8^{th} Line and 10^{th} Line. Accuracy of this approach was verified by using streamflow data of Belfountain gauge (refer to paragraph 11).
2. The $7Q_{20}$ values calculated for the West Credit River at 10^{th} Line in the previous memos have included a climate change impact factor. Therefore, the calculated value of $7Q_{20}$ was reduced by 10%. For consistency results the same approach was used to **update the $7Q_{20}$ value for the Water Year at 10^{th} Line, which equals to 0.225 m^3/sec (Table A.1)**, i.e. deviation from the March 2015 value is less than 2%.

APPENDIX A

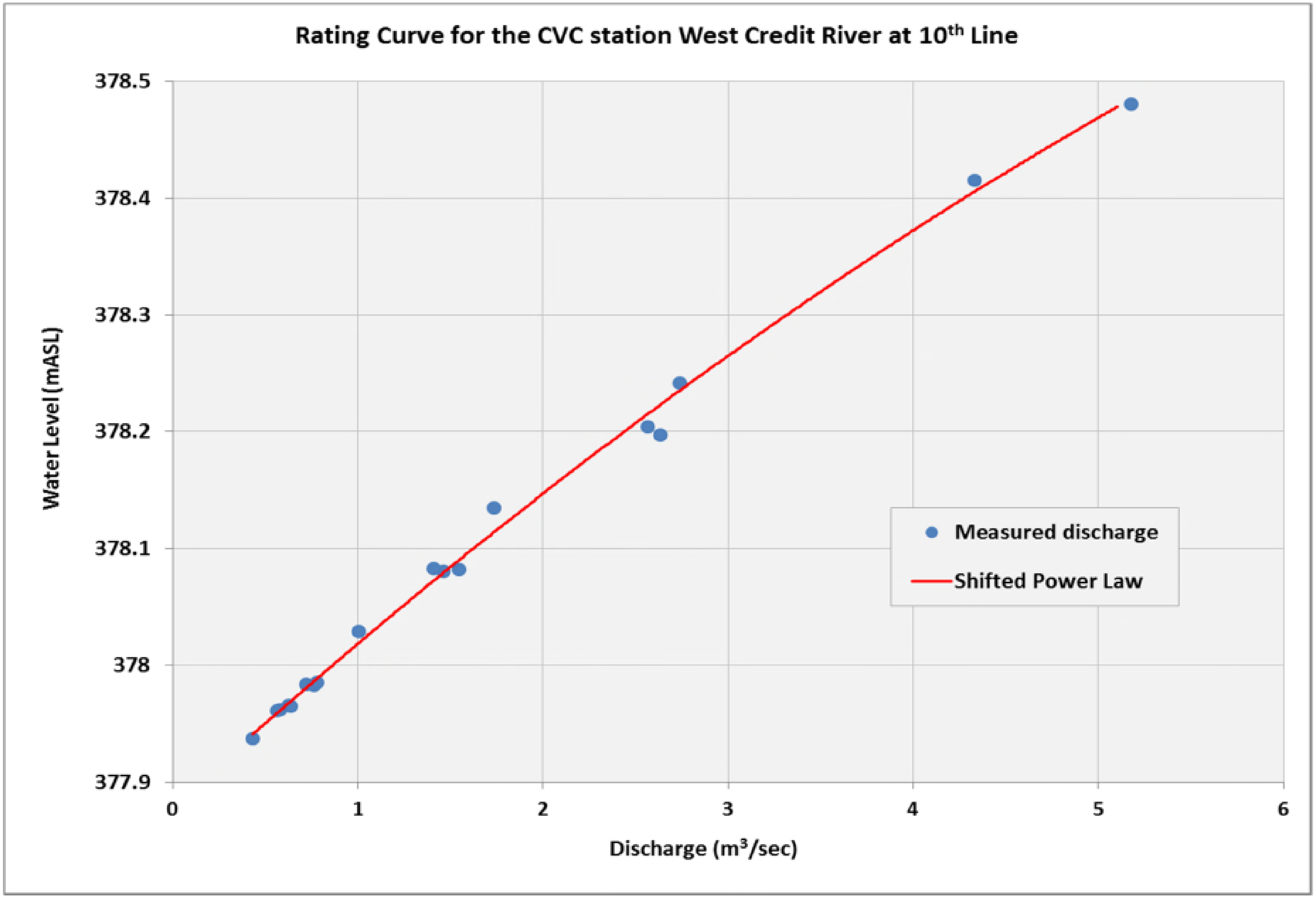


Figure A.1 Rating Curve for the CVC station West Credit River at 10th Line

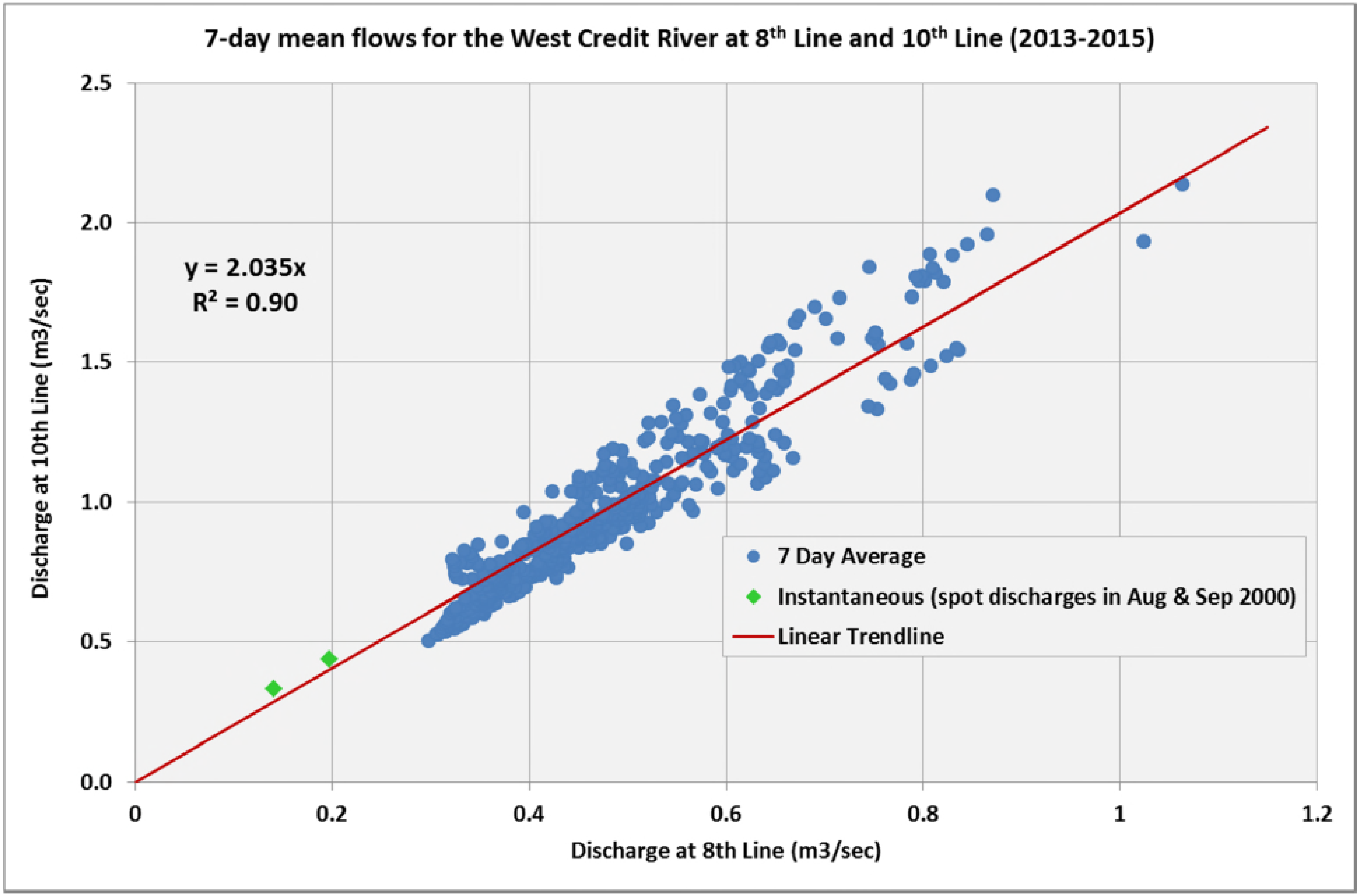


Figure A.2 **Scatter graph of 7-day mean flows for the West Credit River at 8 th Line and 10th Line (July 2013 - November 2015)**

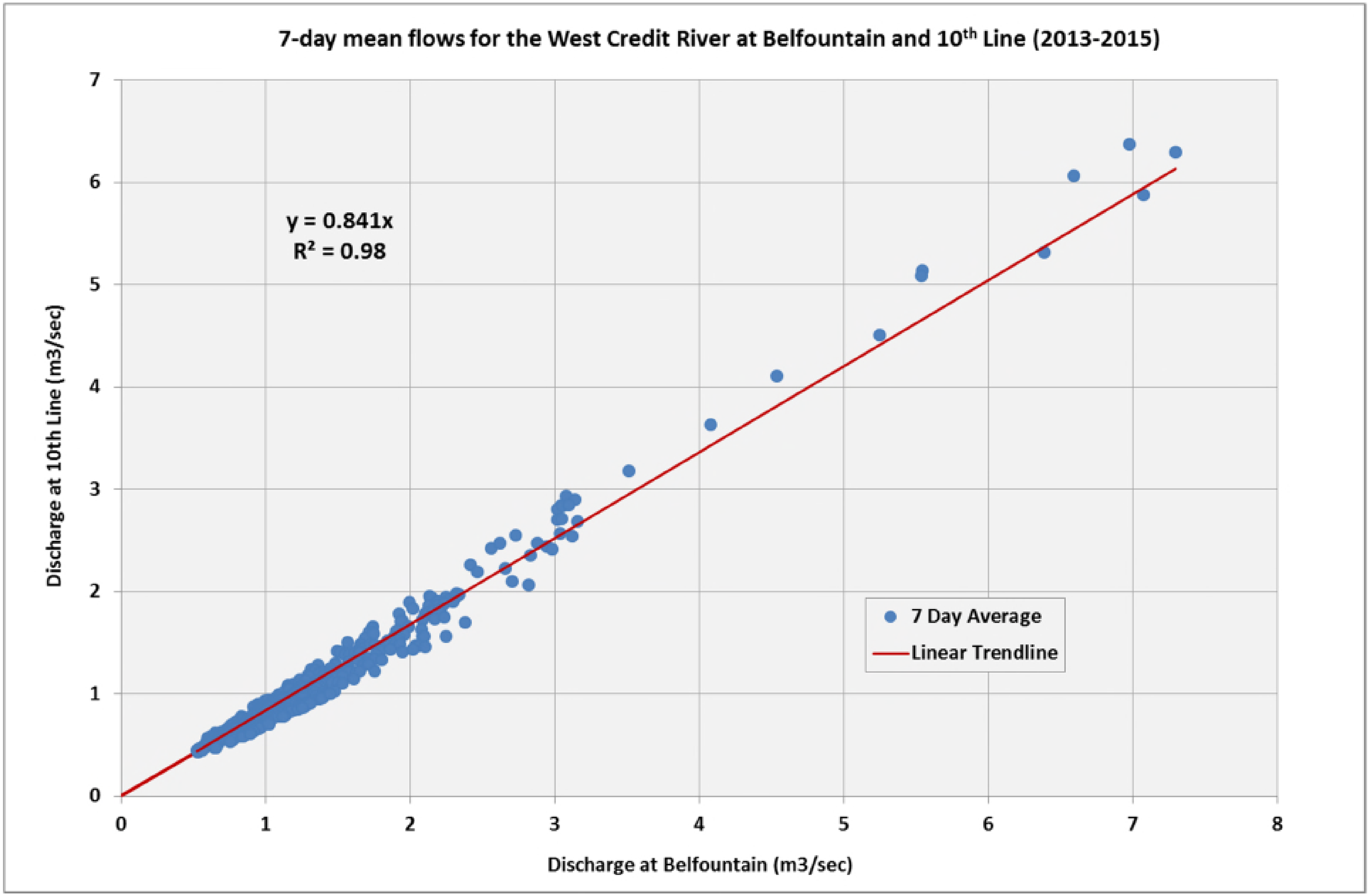


Figure A.3 Scatter graph of 7-day mean flows for the West Credit River at Belfountain and 10 th Line (July 2013 - November 2015)

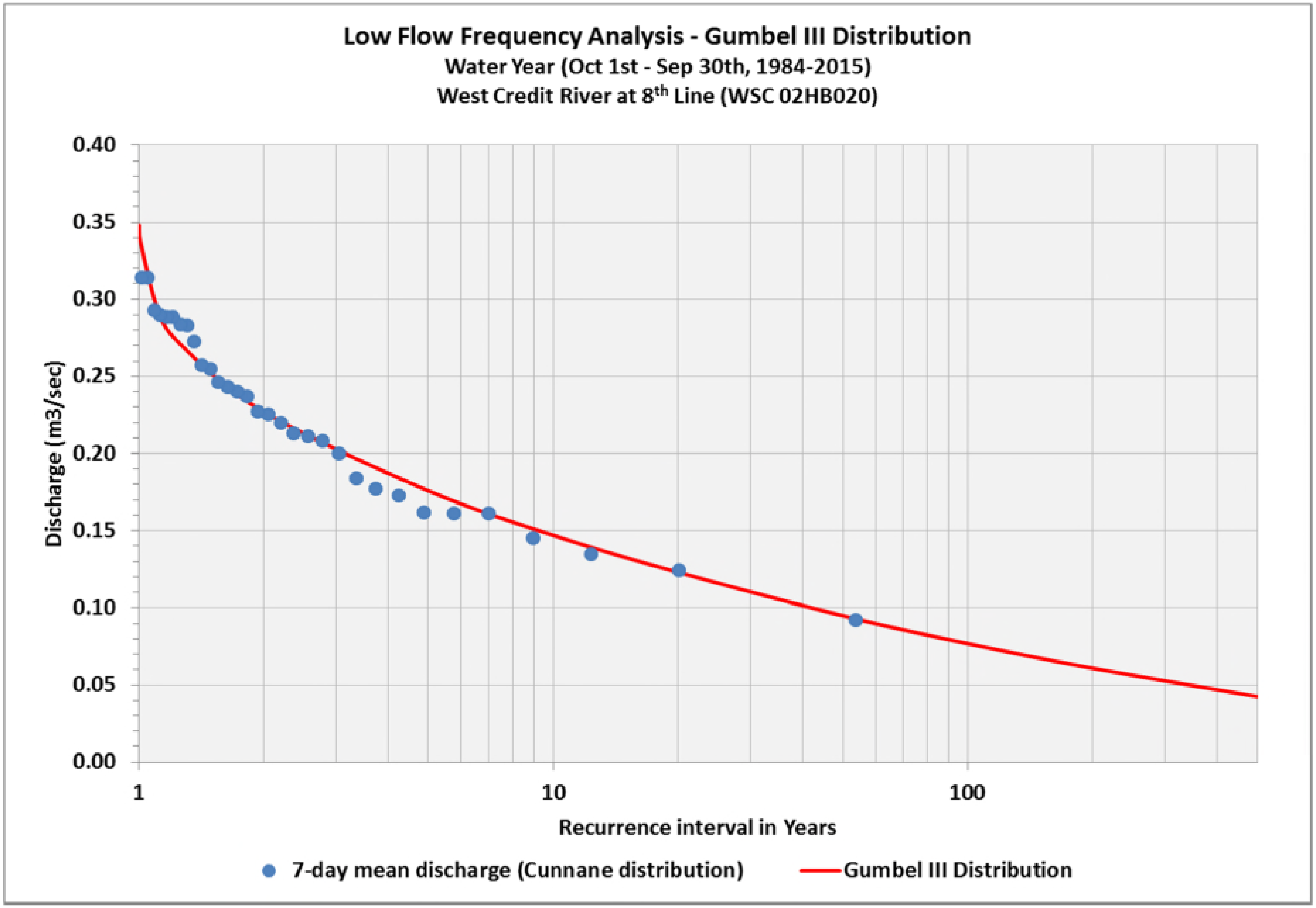


Figure A.4 Gumbel III and Cunnane frequency distributions of minimum 7-day discharges for the West Credit River at 8 th Line (WSC gauge 02HB020) for Water Year (1984-2015)

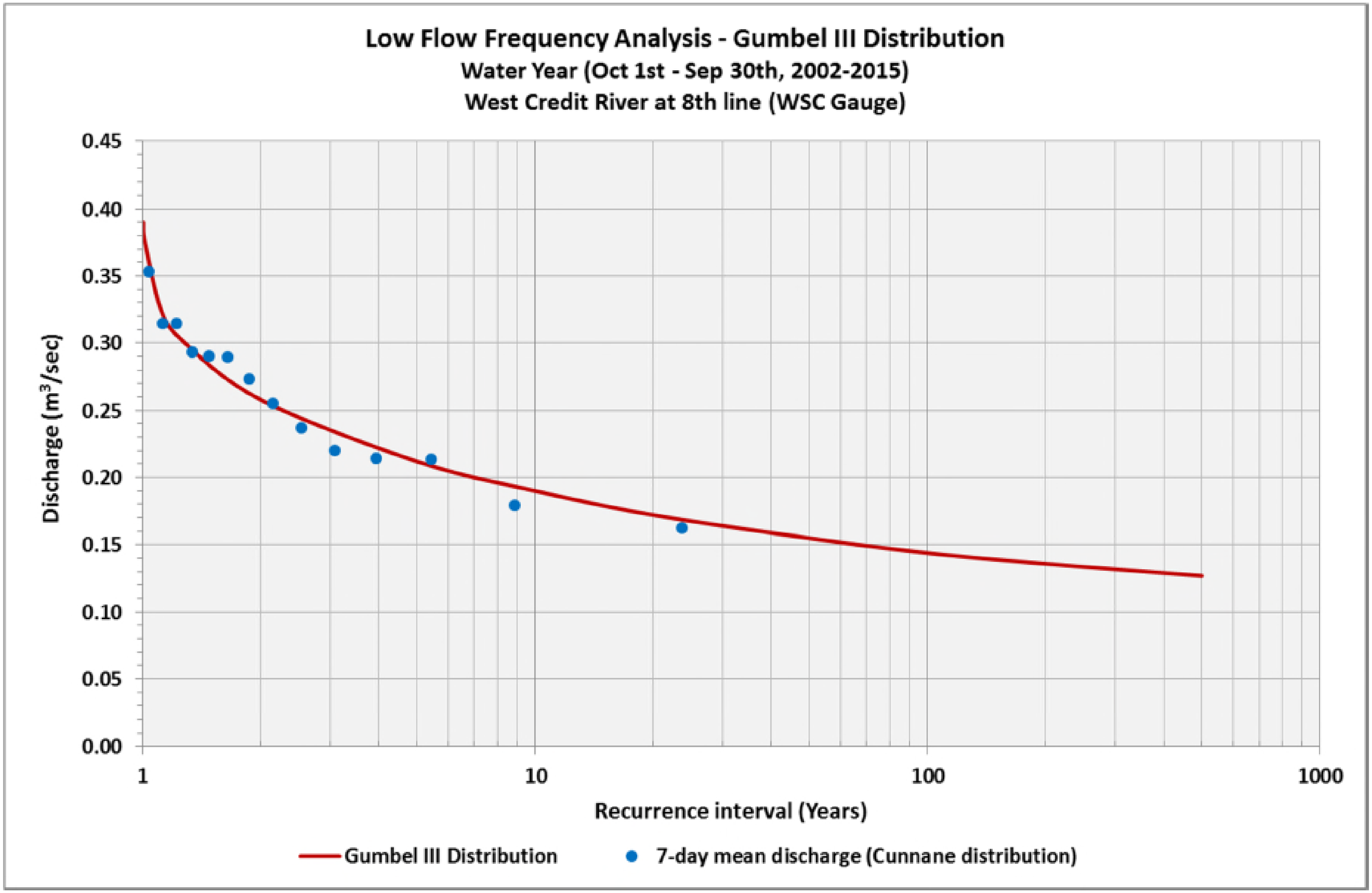


Figure A.5 **Gumbel III and Cunnane frequency distributions of minimum 7-day discharges for the West Credit River at 8 th Line (WSC gauge 02HB020) for Water Year (2002-2015)**

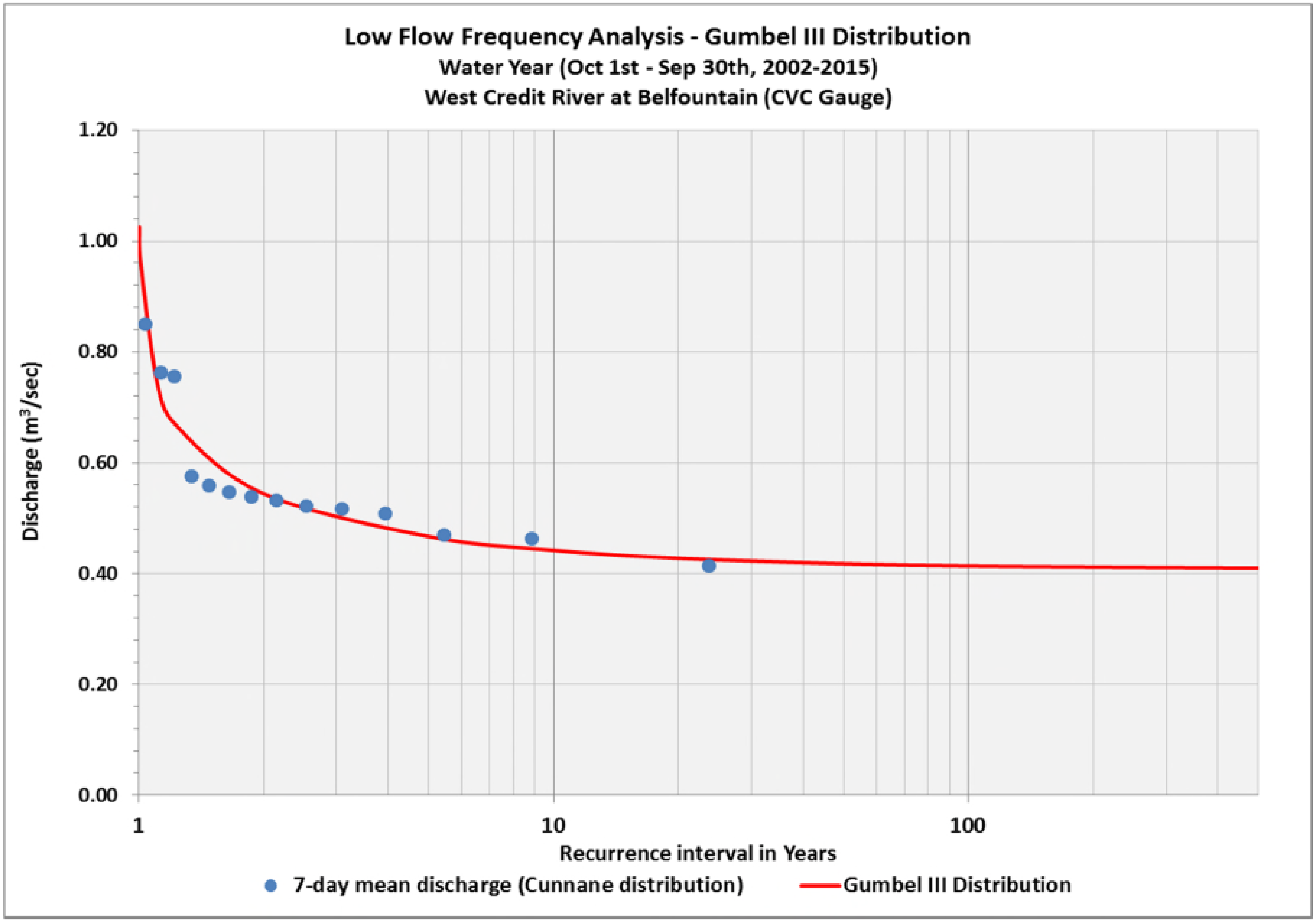


Figure A.6 Gumbel III and Cunnane frequency distributions of minimum 7-day discharges for the West Credit River at Belfountain (CVC gauge) for Water Year (2002-2015)

Table A.1 7Q20 monthly, seasonal and Water Year flows for the West Credit River at 8th Line and 10th Line (m^3/sec) - June 2016

Site/ Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Summer Min (Jul-Sep)	Fall-Winter-Spring Min (Oct-Jun)	Water Year Min (Oct 1-Sep 30)	Including 10% CC factor
8th Line (WSC Gauge)*	0.185	0.251	0.253	0.204	0.195	0.253	0.310	0.227	0.167	0.174	0.150	0.133	**0.132**	**0.151**	**0.123**	**0.111**
10th Line (CVC Gauge)**	0.376	0.511	0.515	0.415	0.397	0.515	0.631	0.462	0.340	0.354	0.305	0.271	**0.269**	**0.307**	**0.250**	**0.225**
Difference (%) ***	16.1	19.2	19.1	17.8	17.1	19.1	16.8	18.9	13.6	14.7	10.2	5.5	5.2	10.4	1.9	1.9

Notes:

* $7Q_{20}$ low flows (monthly, seasonal and yearly values) at 8th Line were estimated by frequency analysis of long-term streamflow data of the WSC gauge (1984-2015).

** $7Q_{20}$ low flows (monthly, seasonal and yearly values) at 10th Line were estimated by linear trendline equation defining relationship between streamflows at 8th Line and 10th Line. The ratio of 10th Line flow to 8th Line flow equal to 2.035.

*** Difference between present 7Q20 values (Jun 2016) and 7Q20 values from the March 14th Memo, calculated for the West Credit at 10th Line.

Table A.2 7Q20 monthly, seasonal and Water Year flows for the West Credit River at 8th Line and 10th Line (m3/sec) - March 2016

Site/ Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Summer Min (Jul-Sep)	Fall-Winter-Spring Min (Oct-Jun)	Water Year Min (Oct 1-Sep 30)	Including 10% CC factor
8th Line (WSC Gauge)	0.185	0.251	0.253	0.204	0.195	0.253	0.310	0.227	0.167	0.174	0.150	0.133	**0.132**	**0.151**	**0.123**	**0.111**
10th Line (CVC Gauge)	0.316	0.413	0.416	0.341	0.329	0.416	0.525	0.375	0.294	0.302	0.274	0.256	**0.255**	**0.275**	**0.246**	**0.221**
Ratio (10th Line/ 8thLine)	1.7	1.6	1.6	1.7	1.7	1.6	1.7	1.7	1.8	1.7	1.8	1.9	**1.9**	**1.8**	**2.0**	**2.0**

Appendix C. Physical Attributes Survey Field Notes

★ = channel & bankslope msmt locations.

General notes:

- Bottom is fine sediment w some cobbles & rocks. Ratio of fines to rocks/cobbles changes back & forth as you move downstream.

(over)

★ = Channel & bank slope msmt locations

Appendix D. Downstream TP Target Memorandum

Suite 202 – 501 Krug Street, Kitchener, ON N2B 1L3 │ 519-576-1711

Memorandum

Date: **October 20, 2016**

To: **Gary Scott, Ainley Group**

From: **Deborah Sinclair, Neil Hutchinson and Tara Roumeliotis**

Re: **J160005 – Recommended Downstream TP Target for West Credit River at Winston Churchill Blvd.**

The Town of Erin (Town) is currently completing a Schedule C Class EA for a proposed Waste Water Treatment Plant (WWTP) to service the existing population and proposed new growth in Erin and Hillsburgh. The proposed phasing of the plant will eventually accommodate Full Build Out of the Town's official plan with additional capacity for growth. Ainley Group (consultants for the Town) requested that Hutchinson Environmental Sciences Ltd (HESL) recommend a downstream water quality target for Total Phosphorus (TP) for the West Credit River at Winston Churchill Blvd. as input to determining the effluent flow and treatment limits for the proposed WWTP.

The Ontario Ministry of the Environment and Climate Change (MOECC) provides guidance on the management of surface water and groundwater quality and quantity for the Province of Ontario. They have established a Provincial Water Quality Objective (PWQO) of 0.03 mg/L for Ontario rivers and Policy 1 for management of surface water quality which states *"In areas which have water quality better than the PWQO, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed …"*.

This memo provides information and a rationale to support a permissible lowering of water quality in the West Credit River from discharge of treated municipal waste water from the proposed Erin WWTP.

TP Concentrations in West Credit River at 10th Line and Winston Churchill Blvd.

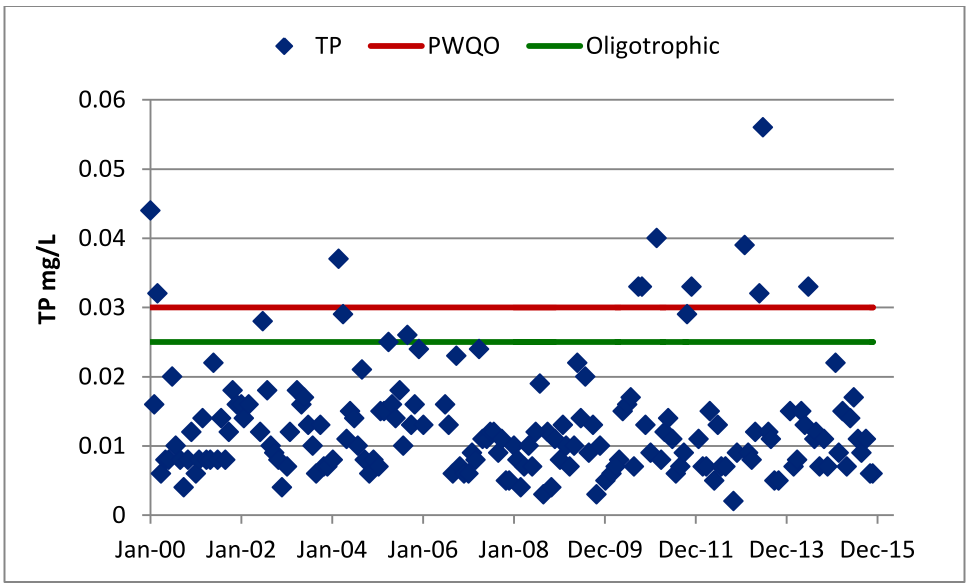
Total phosphorus (TP) concentrations in the West Credit River have been monitored as part of the Ministry of the Environment and Climate Change's (MOECC) Provincial Water Quality Monitoring Network (PWQMN) at Winston Churchill Boulevard since 1975 (station 6007601502). The median (2005 - 2015) and 75th percentile TP concentrations (0.011 mg/L and 0.015 mg/L) are well below the Provincial Water

Quality Objective[1] (PWQO) of 0.03 mg/L. Concentrations are stable; with no apparent increasing or decreasing trend over time (Figure 1).

TP measurements were also collected from the West Credit River upstream of Winston Churchill at 10th Line by Credit Valley Conservation (CVC) in 2007 and 2008 (CVC 2011) and by HESL in 2016 (unpublished data). The median and 75th percentile TP concentrations at 10th Line were also well below the PWQO at 0.014 mg/L and 0.016 mg/L, respectively (based on 15 measurements). The lower TP concentrations, and hence better water quality, at Winston Churchill is due to groundwater discharge to the river between the two stations (CVC 2011).

In 2016, HESL collected chlorophyll "*a*" samples from 10th Line on five occasions. Concentrations ranged from 0.598 µg/L to 3.91 µg/L, with a median of 2.63 µg/L.

Figure 1 Total Phosphorus concentrations measured (2000-2015) in the West Credit River at Winston Churchill Blvd. (PWQMN station 6007601502)



Trophic Status of West Credit River and Implications

Total phosphorus is the key limiting nutrient in plant and algal growth in freshwater systems. Increases in total phosphorus concentrations often results in increased algal biomass (e.g. Dodds et al., 1997). Phosphorus concentrations are therefore commonly used to classify lakes and rivers according to their nutrient ("trophic") status[2] (e.g. oligotrophic, mesotrophic, and eutrophic). Generally oligotrophic systems have low nutrients, low algal biomass, high water clarity, and can support a cold-water fishery. Eutrophic

---

[1] *The PWQO are numerical and narrative criteria that serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e. lakes and rivers) and where it discharges to the surface, the groundwater of the province of Ontario. The PWQO are set at a level of water quality, which is protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to the water (MOEC 1994a).*

[2] *Trophic status – the availability of growth limiting nutrients (Smith et al. 1999) such as total phosphorus or nitrogen.*

systems are nutrient enriched (high nutrient concentrations), have high algal biomass, can have frequent algal blooms, and wide swings in dissolved oxygen (with potential for conditions of no oxygen (anoxia)). Mesotrophic systems have intermediate characteristics (Dodds et al., 1998).

The trophic status classification of the West Credit River between the 10th Line and Winston Churchill Blvd. is oligotrophic using the spot TP data from 10th Line, the long-term PWQMN data and the recent chlorophyll "*a*" data from 10th Line. The oligotrophic classification is based on a trophic status system developed for temperate streams by Dodds et al. (1998; Table 1).

Table 1 Trophic classification boundaries for streams (based on Dodds et al., 1998)

Trophic Level	TP (mg/L)	Suspended Chlorophyll *a* (µg/L)
Oligotrophic	<0.025	<10
Mesotrophic	0.025-0.075	10-30
Eutrophic	>0.075	>30

The West Credit River discharges to the Credit River downstream of Belfountain. The median and 75th percentile (2005-2014) TP concentrations of the Credit River downstream of Belfountain, at Highway 10 (PWQMN station 06007605202) are 0.031 mg/L and 0.052 mg/L respectively; above the PWQO of 0.03 mg/L.

The MOECC provides guidance on the management of surface water and groundwater quality and quantity for the Province of Ontario. In their document: *Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy (MOE 1994a)* two policies relate to the protection of water quality:

> Policy 1 – *In areas which have water quality better than the PWQO, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed …"*
>
> Policy 2 - Water quality which presently does not meet the PWQO shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.

The West Credit River at Erin is therefore managed under MOECC Policy 1 which allows some degradation of water quality, but flows into the main trunk of the river downstream of Belfountain which is managed under Policy 2 such that no additional degradation is allowed and remediation measures are encouraged. The discharge of effluent from the proposed Erin WWTP must not, therefore, contribute to any additional degradation of the main Credit River downstream.

For the purposes of the Schedule C Class EA, the MOECC stated (Paul Odom, October 3, 2016 Core Management Team Meeting) that the MOECC Policies are guidance statements, and that the Town of Erin may not increase the TP concentration in the West Credit River beyond the PWQO of 0.03 mg/L.

They did note, however, that if the Town of Erin discharge were to increase total phosphorus concentrations in the river to 0.03 mg/L that there would be no remaining assimilation capacity to accommodate other dischargers on this reach of the river or downstream, such as industrial dischargers or other municipalities, or to accommodate stormwater runoff. We note that the MOECC guidance does not encourage dischargers to discharge up to the PWQO, but states "… *some lowering of water quality is permissible in these areas…".* Therefore, MOECC suggested that the study team recommend a downstream objective and rationale for total phosphorus for consideration by MOECC. The downstream objective, because it differs from the MOECC generic PWQO of 0.03 mg/L, would be considered a Site Specific Water Quality Objective (CCME 2003).

The PWQO of 0.03 mg/L represents a two-fold increase over the current 75th percentile TP (0.015 mg/L) concentration and a change in trophic status from oligotrophic to mesotrophic in the West Credit River between 10th Line and Winston Churchill Boulevard. CVC has designated the West Credit River downstream of 10th Line as a cold-water aquatic community due to the presence of brook trout. The most productive brook trout spawning reaches and the best brook trout populations in the West Credit River are located downstream of Erin Village (CVC 2011) and the longest contiguous brook trout habitat in the Credit River watershed is the West Credit River between Erin and Belfountain. The effect of doubling the TP concentration, thus changing the trophic status of the river, on brook trout and other aquatic life in the West Credit River is not well understood but detrimental changes would include increased growth of algae attached to bottom substrate (periphyton) which impairs habitat for fish spawning and benthic invertebrates and increased dissolved oxygen concentrations during the day and decreased concentrations at night in response to increased algal respiration which would stress aquatic life. A cautionary approach to establishing a target downstream TP concentration for the purposes of defining the flow and treatment limits is therefore recommended to protect aquatic life.

The following sections review available guidance to develop a downstream phosphorus objective for the West Credit River that will protect the cold water fishery. We then recommend an effluent TP limit that will meet the objective in the river at the projected effluent flows.

Environment Canada Framework for Managing Phosphorus

Environment Canada (2004) has developed a guidance framework for managing phosphorus concentrations in fresh water systems that is consistent with Canada Council of Ministers of the Environment (CCME) guideline development principles, but permits site-specific management of phosphorus. It was published as part of their *Ecosystem Health: Science-based Solutions* series which is dedicated to the dissemination of information and tools for monitoring, assessing and reporting on ecosystem health to support Canadians in making sound decisions (Environment Canada 2004). The guidance recommends a trigger approach to setting and establishing thresholds for TP concentrations. The framework steps include:

- Set ecosystem goals and objectives (enhance, protect, or restore)
- Define reference/baseline conditions
- Select trigger ranges
- Determine current TP concentrations
- Compare current concentrations and concentrations predicted from an undertaking to the trigger range

- Compare current concentrations and concentrations predicted from an undertaking to the baseline

In this case, the goal is to protect the sensitive brook trout population and maintain a healthy diverse aquatic system, while servicing existing development in Erin Village and Hillsburgh and allowing for new growth in the Town. The reference/baseline conditions in the river are well understood, and in this case represent the current concentrations of total phosphorus, which have not shown any increasing/decreasing trend in the last 15 years.

The Canadian Council of Ministers of the Environment (CCME 2003, p.15) provides the following guidance on setting Site Specific Water Quality Objectives (SSWQOs):

> *Two distinct strategies are commonly used to establish WQOs in Canada, including the antidegradation strategy and the use protection strategy. For water bodies with aquatic resources of national or regional significance, the WQOs are established to avoid degradation of existing water quality. For other water bodies, the WQOs are established to protect the designated uses of the aquatic ecosystem. As long as the designated water uses are protected, some degradation of existing water quality may be acceptable in these water bodies, provided that all reasonable and preventative measures are taken to protect water quality conditions.*

The brook trout population in the West Credit River is of regional significance and the West Credit River is the only portion of the Credit River sustaining Policy 1 oligotrophic waters. Therefore the Site Specific Water Quality Objective should be focused on "antidegradation" to maintain the oligotrophic status of the river.

CCME (2003) identifies four methods for developing a SSWQO; the background concentration procedure, recalculation procedure, water effect ratio procedure, and the resident species procedure. The "background concentration procedure" is appropriate for the West Credit River. *"In the background concentration procedure, the natural background concentrations of a contaminant in water …are determined and these levels are used to define acceptable water quality conditions at the site under consideration. Its use is based on the premise that surface water systems with superior water quality (i.e., relative to the Canadian WQGs) should not be degraded. This approach has been used most commonly to define WQOs for relatively pristine water bodies, including several river systems in Canada (e.g., Dunn 1989; MacDonald and Smith 1990). It has also been used in somewhat contaminated water bodies, such as Burrard Inlet (Nijman and Swain 1989)."* (CCME 2003, p. 19). We used three approaches to define the background concentration and resultant SSWQO for the West Credit River.

Although the natural background concentrations of total phosphorus in the West Credit River are not known, current concentrations are low and exceptional for Southern Ontario and are a reasonable approximation of natural background levels. The background concentration procedure uses the upper limit of the natural background concentration of a contaminant to define acceptable water quality conditions (CCME 2003). In this case the "natural" background concentration is the current stable TP concentration of the receiver, prior to the input from the WWTP. The two examples provided to determine the upper limit are the mean concentration plus two standard deviations and the 90th percentile concentration. For the West Credit River at Winston Churchill Blvd. these values are 0.030 mg/L (mean = 0.012 mg/L, standard deviation = 0.009 mg/L) and 0.024 mg/L respectively. Since the data are highly variable (2 x standard deviation is greater than the mean) this approach is not protective of water quality.

Using the 90th percentile approach to establish the upper limit of the background concentration of 0.024 mg/L is recommended, and recognizes the oligotrophic nature of the receiver.

> **Therefore, use of the background concentration procedure for derivation of the SSWQO will define the natural background concentration of the West Credit River as the 75th percentile total phosphorus concentration (=0.016 mg/L) with the upper limit defined by the 90th percentile concentration of 0.024 mg/L.**

A trigger range is defined as a "desired concentration range for phosphorus; if the upper limit of the range is exceeded, that indicates ***a potential*** environmental problem, and therefore **"triggers" further investigation**. The internationally-accepted Organization for Economic Co-operation and Development (OECD) trophic status values are the recommended trigger ranges (Table 2) for Canadian lakes and rivers (CCME 2004). These trophic values were originally established for lakes and reservoirs (Environment Canada 2004), which is why they differ slightly than those presented in Table 1. Rivers can, however, sustain higher loads of TP than lakes before any observable changes in community composition and biomass (Smith et al. 1999): TP is flushed through the system before it can be taken up and utilized by aquatic plants. Therefore, the United States Environmental Protection Agency (USEPA) has adopted trophic classification for rivers based on the Dodds et al. values (Table 1), which are higher than the OECD values.

Table 2 Recommended trigger ranges for Canadian Lakes and Rivers (CCME 2004)

Trophic Status	TP concentration (μg/L)
Ultra-oligotrophic	< 4
Oligotrophic	4-10
Mesotrophic	10-20
Meso-eutrophic	20-35
Eutrophic	35-100
Hyper-eutrophic	>100

> **We recommend using the Dodds et al (1998) trigger ranges as they have specifically been established for rivers in temperate sites. The oligotrophic trophic range is <0.025 mg/L TP (Table 1); therefore a downstream concentration over 0.024 mg/L TP would indicate a potential shift to mesotrophic classification and trigger further investigation.**

In addition to the trigger ranges, the Environment Canada guidance also recommends comparing predicted concentrations to baseline conditions, and notes that *"up to a 50% increase in phosphorus concentrations above the baseline level is deemed acceptable"…"If a 50% increase from baseline is not observed, then there is considered a low risk of adverse effects….if the increase is greater than 50%, the risk of observable effects is considered to be high and further assessment is recommended*" (Environment Canada 2004). We established a natural background 75th percentile concentration of 0.016 mg/L in the West Credit River at Erin. A 50% increase above this results in a trigger concentration of 0.024 mg/L.

Use of the Environment Canada guidance of a 50% increase above background supports a total phosphorus concentration of 0.024 mg/L as an upper range to protect the oligotrophic waters of the West Credit River.

We therefore recommend a value of 0.024 mg/L as the SSWQO for total phosphorus in the West Credit River.

Conclusions and Recommendations

We therefore recommend that a downstream SSWQO of 0.024 mg/L TP be adopted to protect the cold water habitat and water quality in the West Credit River, consistent with Environment Canada and CCME guidance. This will maintain the current trophic status of the river. A higher water quality objective is not recommended as the effect of changing the trophic status of the river on brook trout and other aquatic life in the West Credit River is not well understood at this time.

Water quality objectives are developed as guidelines and not as enforced regulatory standards. They are conservative, in that the best scientific information concludes that aquatic life will be protected at concentrations below the objective but this does not mean that the ecosystem will necessarily be impaired if concentrations increase above the objective. Therefore, Environment Canada (2004) states that, if total phosphorus concentrations increase to the SSWQO, the management response is investigation to determine if the changes have been harmful or if further increases can be sustained. This provides the opportunity for adaptive management of discharge from the proposed WWTP at Erin.

During Phase 1 of the WWTP, we recommend that the Town implement a receiver monitoring program for the West Credit River to determine the resultant phosphorus concentration in the river and assess any effects of increased TP loadings on water quality and aquatic communities (e.g. algal, benthos and fish). Effluent monitoring is also required to confirm that the lower effluent limits and objectives required to accommodate future growth can be met. The findings from these monitoring studies can:

a) inform a future application to rerate the Erin WWTP to accommodate a higher wastewater flow at a lower effluent TP concentration if monitoring shows that the plant can be operated at a lower effluent limit,

b) inform a decision to maintain the downstream West Credit River TP objective at 0.024 mg/L at Full Build Out or if it can be relaxed to 0.027 mg/L with no threat to aquatic life to accommodate either a higher population or a higher effluent limit.

Phosphorus Control for New Development

Wastewater discharge will not be the only source of total phosphorus to the West Credit River as the Town of Erin is serviced and grows. New development, infill and intensification of development will increase impervious services in Erin and Hillsburgh, leading to increased runoff of stormwater which will contain phosphorus and other pollutants. Growing recognition of non-point source pollution by urban runoff has led to increased demands for management of stormwater quality, as well as quantity. New development in the Lake Simcoe and Nottawasaga River watersheds and in the City of Oakville, for example, must set a target of “net zero” increase in phosphorus loading, such that the cumulative phosphorus loading from municipal wastewater effluent and stormwater runoff must not increase between the pre-development and post-development condition. Jennifer Dougherty, of Credit Valley Conservation stated that this was typically required for cases where the receiving waters were Policy 2 but that this would not be required for Erin[3]. Nevertheless, the sensitivity of the West Credit River at Erin may stimulate requests for phosphorus abatement from stormwater as Erin and Hillsburgh are built out.

Decommissioning of septic systems upon completion of the Erin WWTP will reduce one source of phosphorus (and nitrate) loading to the watershed. Development and redevelopment can reduce phosphorus loading in storm water through implementation of improved stormwater management (Best Management Practices) for older areas and Low Impact Development Techniques, particularly infiltration of runoff for new development. Infiltration techniques reduce surface runoff volume, remove particulates and suspended solids from runoff (including particulate phosphorus), encourage adsorption of phosphorus onto mineral surfaces in soils and cool the runoff, all of which will protect the cold water habitat in the West Credit River and help offset the discharge form the new WWTP.

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[3] *October 3, 2016 Core Management Team Meeting)*

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Appendix E. Email Correspondence from MOECC on Effluent Limits

Tara Roumeliotis

From: Christine Furlong <cfurlong@tritoneng.on.ca>
Sent: October-03-16 3:21 PM
To: scott@ainleygroup.com
Cc: Simon Glass (glass@ainleygroup.com); 'jdougherty@creditvalleyca.ca'; Noah Brotman (noahbrotman@hardystevenson.com); mullan@ainleygroup.com; Neil Hutchinson; 'garyc@wellington.ca'; Dave Hardy (davehardy@hardystevenson.com); Deborah Sinclair; Tara Roumeliotis; 'Ray Blackport (blackport_hydrogeology@rogers.com)'; Barb Slattery
Subject: FW: Comments on Today's meeting
Attachments: 1160-9ESQPY-14.pdf

Hello Gary

Barb Slattery has provided some comments from MOECC on effluent quality for the Town of Erin WWTP discharge based on the Environmental Compliance Approval (ECA) for the Orangeville WWTP.

Attached is the Orangeville ECA in its entirety from the Access Environment portal.

Christine Furlong, P. Eng

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From: Slattery, Barbara (MOECC) [mailto:barbara.slattery@ontario.ca]
Sent: October-03-16 2:59 PM
To: Christine Furlong
Subject: Comments on Today's meeting

Hello Christine, would you be so kind as to distribute this email to the rest of the group. As I noted, Paul and Craig wanted to make some comments on Table 4 on page 3 of the slide deck. Here they are:

Using the Orangeville WPCP ECA (2014) for comparison – a plant which discharges to the headwaters of the Credit. Orangeville is currently upgrading (summer 2018 completion) and has current and future numbers (we have used Objective/Limit notation in the following)

a) pH – is this actually meaning pH to be *between* 7 & 8.6. Achieving this is hightly desireable given that this is prime trout rearing habitat. (Orangeville is 6-9.5)
b) TSS – While this is not a PWQO parameter, it it can be designed for 3mg/l, the limit should be 5mg/l (Orangeville is 5/7.5 upgrading to 4/5). The issue is reducing to the maximum extent possible the discharge of solids material to the pools and substrates of one of GTA's prime spawning/rearing habitats.
c) TAN – With an objective of 0.4mg/l, they have proposed a limit of 2mg/l. This difference is likely driven by variations during winter conditions. Limits of 1.3 mg/l (May-October) and 2.0mg/L (November-April) should be readily achievable with a design of 0.4.
d) TKN at 3 mg/l and NO_3 at 5/6 mg/l are OK
e) E Coli at 100 are OK
f) D.O. in the effluent is OK at 5/4 (minimum values)
g) If BOD_5 is $tBOD_5$, OK. If it is $cBOD_5$, the limit should be 5. (Orangeville is 5/7.5 going to 4/5). Most modern facilities achieve $cBOD_5$ <2 (MDL) for most of their analyses (barring upset/spill).
h) Temperature: we presume the values quoted are <17°C objective and 8-19°C limit. Temperature is almost impossible to control within a WPCP; however, influent is usually fairly consistent. In the future, the ministry's review engineer will decide if temperature should be tabulated. Obviously the lower the temperature, the better for both the cold water species and ammonia dissociation.

Thank you

Barb Slattery, EA/Planning Coordinator
Ministry of the Environment and Climate Change
West Central Region
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Appendix F. QUAL2K Output Data

Constituent (Average) Summary - Phase 1 Flows (3380 m3/d)

Tributary Label	Reach Lab	x(km)	cond (umhos)	ISS (mgD/L)	DO(mgO2/L)	CBODf (mgO2/L)	No(ugN/L)	NH4(ugN/L)	NO3(ugN/L)	Po (ugP/L)	Inorg P (ugP/L)	Phyto (ugA/L)	Pathogen	Alk	pH	TOC	TN	TP	TKN	TSS (mgD/L)	CBODu	NH3	DO sat	pHsat
main	Mainstem	1.70	613.00	3.20	7.72	2.78	535.00	55.00	1900.00	7.90	8.10	2.72	160.00	281.00	8.21	1.14	2509.58	18.72	609.58	3.47	3.07	3.60	8.50	8.86
		1.67	613.00	3.17	7.73	2.76	533.68	53.89	1898.82	7.70	8.07	2.68	149.99	280.99	8.21	1.13	2505.65	18.45	606.83	3.44	3.05	3.58	8.48	8.86
		1.60	613.00	3.15	7.74	2.74	532.36	52.80	1897.63	7.51	8.05	2.63	140.87	280.99	8.22	1.12	2501.74	18.19	604.10	3.42	3.02	3.57	8.47	8.86
		1.54	670.17	3.40	7.07	3.01	702.63	226.44	2363.98	11.29	12.00	2.19	121.98	286.67	8.28	1.21	3308.85	25.48	944.87	3.62	3.25	17.10	8.51	8.87
		1.47	670.17	3.38	6.97	2.97	701.09	219.31	2369.32	11.09	11.98	2.16	114.09	286.62	8.27	1.19	3305.28	25.24	935.96	3.60	3.21	16.33	8.50	8.87
		1.41	670.17	3.36	6.89	2.93	699.64	212.91	2373.99	10.91	11.96	2.13	107.53	286.57	8.26	1.18	3301.87	25.01	927.89	3.58	3.17	15.68	8.49	8.87
		1.33	670.17	3.34	6.86	2.90	698.31	207.73	2377.37	10.74	11.94	2.10	102.58	286.54	8.26	1.17	3298.56	24.79	921.19	3.57	3.14	15.27	8.48	8.87
		1.24	670.17	3.32	6.83	2.86	696.52	200.92	2381.76	10.51	11.92	2.07	96.57	286.49	8.26	1.15	3294.08	24.50	912.33	3.54	3.10	14.72	8.47	8.87
		1.16	670.17	3.30	6.80	2.82	694.73	194.30	2385.95	10.29	11.89	2.03	91.16	286.44	8.25	1.14	3289.61	24.22	903.66	3.52	3.06	14.21	8.45	8.87
		1.07	670.17	3.28	6.78	2.78	692.83	187.47	2390.20	10.06	11.86	1.99	85.93	286.39	8.25	1.12	3284.86	23.92	894.66	3.49	3.01	13.67	8.44	8.87
		0.97	670.17	3.25	6.75	2.73	690.93	180.85	2394.24	9.83	11.84	1.96	81.19	286.34	8.25	1.10	3280.12	23.63	885.87	3.47	2.97	13.16	8.43	8.87
		0.88	670.17	3.23	6.73	2.69	689.04	174.43	2398.09	9.61	11.81	1.92	76.89	286.30	8.24	1.09	3275.38	23.34	877.30	3.45	2.92	12.68	8.41	8.87
		0.78	670.17	3.21	6.73	2.66	687.36	169.18	2401.14	9.42	11.78	1.89	72.84	286.26	8.24	1.07	3271.30	23.10	870.16	3.42	2.89	12.37	8.39	8.87
		0.69	670.17	3.19	6.73	2.62	685.69	164.04	2404.10	9.24	11.76	1.86	69.20	286.22	8.24	1.06	3267.22	22.86	863.13	3.40	2.85	12.07	8.37	8.87
		0.59	670.17	3.17	6.73	2.59	684.02	159.00	2406.94	9.06	11.74	1.83	65.89	286.18	8.24	1.05	3263.15	22.62	856.21	3.38	2.82	11.77	8.35	8.87
		0.50	670.17	3.15	6.73	2.55	682.35	154.08	2409.68	8.88	11.71	1.80	62.87	286.15	8.24	1.03	3259.08	22.39	849.40	3.36	2.78	11.47	8.33	8.87
		0.43	670.17	3.14	6.80	2.54	681.69	151.31	2410.44	8.79	11.69	1.79	61.67	286.13	8.24	1.03	3256.30	22.26	845.86	3.35	2.77	11.46	8.32	8.87
		0.37	670.17	3.13	6.87	2.52	681.02	148.58	2411.17	8.70	11.67	1.77	60.51	286.11	8.25	1.02	3253.54	22.14	842.37	3.34	2.75	11.43	8.32	8.87
		0.31	670.17	3.10	6.86	2.49	679.24	142.56	2413.01	8.48	11.62	1.74	57.38	286.07	8.25	1.01	3247.33	21.84	834.32	3.32	2.72	11.02	8.30	8.87
		0.22	670.17	3.08	6.85	2.45	677.45	136.68	2414.70	8.27	11.58	1.71	54.50	286.04	8.24	1.00	3241.11	21.55	826.41	3.29	2.68	10.61	8.27	8.87
		0.13	670.17	3.06	6.84	2.42	675.66	131.00	2416.23	8.06	11.53	1.67	51.84	286.00	8.24	0.98	3234.93	21.27	818.70	3.27	2.65	10.21	8.25	8.87
		0.05	670.17	3.03	6.84	2.38	673.87	125.52	2417.60	7.86	11.49	1.64	49.38	285.96	8.24	0.97	3228.80	20.99	811.20	3.25	2.61	9.83	8.24	8.87
	Terminus	0.01	670.17	3.03	6.84	2.38	673.87	125.52	2417.60	7.86	11.49	1.64	49.38	285.96	8.24	0.97	3228.80	20.99	811.20	3.25	2.61	9.83	8.24	8.87

Constituent (Average) Summary - Full Build Out Flows (7172 m3/d)

Tributary Label	Reach Lab	x(km)	cond (umhos)	ISS (mgD/L)	DO(mgO2/L)	CBODf (mgO2/L)	No(ugN/L)	NH4(ugN/L)	NO3(ugN/L)	Po (ugP/L)	Inorg P (ugP/L)	Phyto (ugA/L)	Pathogen	Alk	pH	TOC	TN	TP	TKN	TSS (mgD/L)	CBODu	NH3	DO sat	pHsat
main	Mainstem	1.70	613.00	3.20	7.72	2.78	535.00	55.00	1900.00	7.90	8.10	2.72	160.00	281.00	8.21	1.14	2509.58	18.72	609.58	3.47	3.07	3.60	8.50	8.86
		1.67	613.00	3.17	7.73	2.76	533.68	53.89	1898.82	7.70	8.07	2.68	149.99	280.99	8.21	1.13	2505.65	18.45	606.83	3.44	3.05	3.58	8.48	8.86
		1.60	613.00	3.15	7.74	2.74	532.36	52.80	1897.63	7.51	8.05	2.63	140.87	280.99	8.22	1.12	2501.74	18.19	604.10	3.42	3.02	3.57	8.47	8.86
		1.54	717.29	3.62	6.63	3.29	844.69	218.58	2740.08	11.31	11.92	1.89	118.57	291.43	8.34	1.30	3816.94	25.12	1076.86	3.82	3.50	18.23	8.56	8.87
		1.47	717.29	3.61	6.54	3.24	843.01	212.52	2744.53	11.14	11.91	1.86	111.31	291.39	8.33	1.28	3813.46	24.91	1068.93	3.80	3.45	17.50	8.55	8.87
		1.41	717.29	3.59	6.47	3.20	841.42	207.01	2748.46	10.98	11.89	1.84	105.21	291.35	8.32	1.27	3810.11	24.71	1061.66	3.78	3.41	16.87	8.54	8.87
		1.33	717.29	3.58	6.46	3.17	839.94	202.50	2751.28	10.83	11.87	1.82	100.57	291.31	8.32	1.26	3806.80	24.52	1055.52	3.77	3.38	16.43	8.53	8.87
		1.24	717.29	3.55	6.44	3.13	838.01	196.76	2754.82	10.63	11.85	1.79	95.09	291.27	8.31	1.24	3802.46	24.27	1047.64	3.75	3.34	15.92	8.52	8.87
		1.16	717.29	3.53	6.43	3.09	836.08	191.15	2758.21	10.43	11.83	1.76	90.13	291.23	8.31	1.22	3798.12	24.02	1039.91	3.72	3.29	15.41	8.51	8.87
		1.07	717.29	3.51	6.42	3.04	834.02	185.34	2761.66	10.23	11.81	1.73	85.32	291.18	8.30	1.21	3793.50	23.77	1031.84	3.70	3.25	14.90	8.49	8.87
		0.97	717.29	3.49	6.40	3.00	831.97	179.69	2764.96	10.03	11.78	1.70	80.95	291.14	8.30	1.19	3788.89	23.52	1023.93	3.68	3.20	14.39	8.48	8.87
		0.88	717.29	3.47	6.39	2.96	829.92	174.18	2768.09	9.84	11.76	1.68	76.97	291.10	8.30	1.18	3784.27	23.27	1016.18	3.66	3.16	13.91	8.47	8.87
		0.78	717.29	3.45	6.41	2.92	828.13	169.67	2770.57	9.67	11.74	1.65	73.17	291.06	8.29	1.16	3780.28	23.06	1009.70	3.64	3.12	13.61	8.45	8.87
		0.69	717.29	3.43	6.42	2.89	826.33	165.23	2772.98	9.50	11.72	1.63	69.74	291.03	8.29	1.15	3776.28	22.85	1003.30	3.62	3.09	13.30	8.43	8.87
		0.59	717.29	3.41	6.43	2.85	824.53	160.87	2775.30	9.34	11.70	1.61	66.63	291.00	8.29	1.13	3772.27	22.65	996.98	3.60	3.05	13.01	8.41	8.87
		0.50	717.29	3.40	6.45	2.82	822.74	156.59	2777.53	9.18	11.68	1.58	63.79	290.96	8.29	1.12	3768.27	22.44	990.73	3.58	3.02	12.71	8.39	8.87
		0.43	717.29	3.39	6.54	2.80	822.00	154.21	2778.09	9.10	11.66	1.57	62.69	290.95	8.29	1.12	3765.63	22.33	987.53	3.57	3.00	12.68	8.38	8.87
		0.37	717.29	3.38	6.62	2.79	821.26	151.85	2778.64	9.02	11.64	1.56	61.63	290.93	8.30	1.11	3762.99	22.23	984.36	3.56	2.99	12.65	8.38	8.87
		0.31	717.29	3.35	6.62	2.75	819.28	146.51	2780.05	8.82	11.60	1.54	58.66	290.90	8.30	1.10	3756.90	21.97	976.85	3.54	2.95	12.24	8.36	8.87
		0.22	717.29	3.33	6.62	2.71	817.30	141.33	2781.33	8.63	11.57	1.51	55.94	290.86	8.29	1.08	3750.83	21.71	969.50	3.52	2.91	11.84	8.34	8.87
		0.13	717.29	3.31	6.61	2.68	815.32	136.29	2782.48	8.45	11.53	1.48	53.43	290.83	8.29	1.07	3744.78	21.46	962.30	3.50	2.88	11.46	8.32	8.87
		0.05	717.29	3.29	6.61	2.64	813.34	131.41	2783.50	8.27	11.49	1.46	51.11	290.79	8.29	1.06	3738.76	21.21	955.26	3.48	2.84	11.08	8.30	8.87
	Terminus	0.01	717.29	3.29	6.61	2.64	813.34	131.41	2783.50	8.27	11.49	1.46	51.11	290.79	8.29	1.06	3738.76	21.21	955.26	3.48	2.84	11.08	8.30	8.87

Appendix G. CORMIX Output Data

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CORMIX3 PREDICTION FILE:
333333333333333333333333333333333333333333333333333333333333333333333333333333333
                       CORMIX MIXING ZONE EXPERT SYSTEM
                Subsystem CORMIX3: Buoyant Surface Discharges
                             CORMIX Version 10.0GT
                     HYDRO3 Version 10.0.0.0 July 2016
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   West Credit River
 Design case:       Erin WWTP - 3380
 FILE NAME:         C:\...sktop\Erin EA\CORMIX\Erin WWTP-3380 bank-good.prd
 Time stamp:        11/10/2016--11:54:33

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     11.00  AS    =      4.40  QA    =      0.23  ICHREG= 2
 HA    =      0.40  HD    =      0.30
 UA    =      0.051 F     =      0.130 USTAR =0.6529E-02
 UW    =      2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  997.9542

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.00  Configuration: flush_discharge
 SIGMA =     90.00  HDO   =      0.30  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.200 A0    =      0.031
 Dimensions of equivalent rectangular discharge:
 B0    =      0.157 H0    =      0.200 A0    =0.3142E-01  AR    =      1.273
 U0    =      1.241 Q0    =      0.039       =0.3900E-01
 RHO0  =  998.4062  DRHO0 =-.4520E+00  GP0   =-.4442E-02
 C0    =0.1245E+01  CUNITS=  mg/l
 IPOLL =  2         KS    =0.0000E+00  KD    =0.5787E-04

FLUX VARIABLES (metric units)
 Q0    =0.3900E-01  M0    =0.4841E-01  J0    =-.1732E-03
 Associated length scales (meters)
 LQ    =      0.18  LM    =  99999.00  Lm    =      4.30  Lb    =      0.00
 LQ2D  =      0.10  LM2D  =  99999.00  Lm2D  =     61.72

NON-DIMENSIONAL PARAMETERS
 FR0   =  99999.00  FRCH  =  99999.00  R     =     24.28

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    SA2    3
 3  Applicable layer depth HS =     0.30  3
 3  Limiting Dilution S =QA/Q0=     6.77  3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1245E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2200E+00
 REGMZ =  0
 XINT  =   1500.00  XMAX  =   1500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.00 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP = 100 display intervals per module
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.125E+01   0.20     0.08 .00000E+00

END OF MOD301: DISCHARGE MODULE
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.125E+01   0.20     0.08 .00000E+00

 VERTICAL MIXING occurs in the initial zone of flow establishment.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
```

TT = Cumulative travel time

Control volume outflow: SIGMAE= 89.52

X	Y	Z	S	C	BV	BH	TT
0.00	0.06	0.00	1.0	0.124E+01	0.30	0.09	.51796E-01

Cumulative travel time = 0.0518 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

Surface jet in shallow crossflow with shoreline-attachment.

Profile definitions:
BV = water depth (vertically mixed)
BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction efects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
0.00	0.06	0.00	1.0	0.124E+01	0.30	0.09	.51796E-01
0.08	0.29	0.00	1.3	0.992E+00	0.30	0.12	.27976E+00
0.24	0.48	0.00	1.4	0.885E+00	0.30	0.14	.54407E+00
0.31	0.53	0.00	1.5	0.857E+00	0.30	0.15	.63949E+00
0.45	0.62	0.00	1.5	0.809E+00	0.30	0.17	.84063E+00
0.60	0.69	0.00	1.6	0.768E+00	0.30	0.19	.10549E+01
0.84	0.79	0.00	1.7	0.718E+00	0.30	0.21	.13998E+01
0.92	0.81	0.00	1.8	0.704E+00	0.30	0.22	.15208E+01
1.08	0.86	0.00	1.8	0.677E+00	0.30	0.24	.17717E+01
1.33	0.92	0.00	1.9	0.643E+00	0.30	0.26	.21695E+01
1.41	0.94	0.00	2.0	0.633E+00	0.30	0.27	.23077E+01
1.57	0.98	0.00	2.0	0.614E+00	0.30	0.29	.25925E+01
1.82	1.02	0.00	2.1	0.589E+00	0.30	0.31	.30400E+01
1.99	1.05	0.00	2.2	0.574E+00	0.30	0.33	.33517E+01
2.07	1.06	0.00	2.2	0.567E+00	0.30	0.34	.35115E+01
2.23	1.09	0.00	2.2	0.554E+00	0.30	0.36	.38389E+01
2.40	1.11	0.00	2.3	0.542E+00	0.30	0.37	.41767E+01
2.65	1.15	0.00	2.4	0.525E+00	0.30	0.40	.47027E+01
2.82	1.17	0.00	2.4	0.515E+00	0.30	0.42	.50660E+01
2.90	1.18	0.00	2.4	0.510E+00	0.30	0.42	.52515E+01
3.07	1.19	0.00	2.5	0.501E+00	0.30	0.44	.56299E+01
3.24	1.21	0.00	2.5	0.492E+00	0.30	0.46	.60183E+01
3.49	1.24	0.00	2.6	0.480E+00	0.30	0.48	.66195E+01
3.66	1.25	0.00	2.6	0.473E+00	0.30	0.50	.70326E+01
3.82	1.27	0.00	2.7	0.465E+00	0.30	0.52	.74555E+01
3.91	1.27	0.00	2.7	0.462E+00	0.30	0.52	.76706E+01
4.16	1.29	0.00	2.8	0.452E+00	0.30	0.55	.83305E+01
4.24	1.30	0.00	2.8	0.449E+00	0.30	0.56	.85554E+01
4.41	1.31	0.00	2.8	0.443E+00	0.30	0.57	.90123E+01
4.66	1.33	0.00	2.9	0.435E+00	0.30	0.60	.97157E+01
4.75	1.33	0.00	2.9	0.432E+00	0.30	0.61	.99550E+01
5.00	1.35	0.00	2.9	0.424E+00	0.30	0.63	.10687E+02
5.08	1.36	0.00	2.9	0.422E+00	0.30	0.64	.10936E+02
5.25	1.37	0.00	3.0	0.417E+00	0.30	0.66	.11441E+02
5.50	1.38	0.00	3.0	0.410E+00	0.30	0.68	.12216E+02
5.58	1.39	0.00	3.0	0.408E+00	0.30	0.69	.12479E+02
5.84	1.40	0.00	3.1	0.402E+00	0.30	0.71	.13283E+02
5.92	1.40	0.00	3.1	0.400E+00	0.30	0.72	.13555E+02
6.09	1.41	0.00	3.1	0.396E+00	0.30	0.74	.14107E+02
6.34	1.42	0.00	3.2	0.390E+00	0.30	0.76	.14953E+02
6.42	1.43	0.00	3.2	0.388E+00	0.30	0.77	.15240E+02
6.68	1.44	0.00	3.2	0.383E+00	0.30	0.79	.16114E+02
6.76	1.44	0.00	3.3	0.381E+00	0.30	0.80	.16411E+02
6.93	1.45	0.00	3.3	0.378E+00	0.30	0.82	.17010E+02
7.18	1.46	0.00	3.3	0.373E+00	0.30	0.84	.17926E+02
7.26	1.46	0.00	3.3	0.372E+00	0.30	0.85	.18236E+02
7.52	1.47	0.00	3.4	0.367E+00	0.30	0.87	.19181E+02
7.60	1.47	0.00	3.4	0.366E+00	0.30	0.88	.19501E+02
7.85	1.48	0.00	3.4	0.362E+00	0.30	0.90	.20473E+02
8.02	1.49	0.00	3.5	0.359E+00	0.30	0.92	.21133E+02
8.11	1.49	0.00	3.5	0.358E+00	0.30	0.93	.21467E+02
8.27	1.50	0.00	3.5	0.355E+00	0.30	0.94	.22140E+02
8.53	1.50	0.00	3.5	0.351E+00	0.30	0.97	.23169E+02
8.69	1.51	0.00	3.6	0.349E+00	0.30	0.98	.23866E+02
8.86	1.51	0.00	3.6	0.346E+00	0.30	1.00	.24572E+02
8.95	1.52	0.00	3.6	0.345E+00	0.30	1.01	.24929E+02
9.11	1.52	0.00	3.6	0.343E+00	0.30	1.02	.25649E+02
9.37	1.53	0.00	3.7	0.340E+00	0.30	1.04	.26747E+02
9.53	1.53	0.00	3.7	0.338E+00	0.30	1.06	.27491E+02
9.62	1.53	0.00	3.7	0.337E+00	0.30	1.07	.27866E+02
9.79	1.54	0.00	3.7	0.334E+00	0.30	1.08	.28623E+02
9.95	1.54	0.00	3.7	0.332E+00	0.30	1.10	.29390E+02
10.21	1.55	0.00	3.8	0.330E+00	0.30	1.12	.30557E+02
10.38	1.55	0.00	3.8	0.328E+00	0.30	1.13	.31346E+02
10.46	1.55	0.00	3.8	0.327E+00	0.30	1.14	.31745E+02
10.63	1.56	0.00	3.8	0.325E+00	0.30	1.16	.32548E+02
10.80	1.56	0.00	3.8	0.323E+00	0.30	1.17	.33360E+02

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     11.05     1.56    0.00     3.9 0.321E+00   0.30     1.19 .34596E+02
     11.22     1.57    0.00     3.9 0.319E+00   0.30     1.21 .35432E+02
     11.30     1.57    0.00     3.9 0.318E+00   0.30     1.22 .35853E+02
     11.47     1.57    0.00     3.9 0.316E+00   0.30     1.23 .36702E+02
     11.64     1.57    0.00     3.9 0.315E+00   0.30     1.25 .37560E+02
     11.89     1.58    0.00     4.0 0.312E+00   0.30     1.27 .38864E+02
     12.06     1.58    0.00     4.0 0.311E+00   0.30     1.28 .39745E+02
     12.14     1.58    0.00     4.0 0.310E+00   0.30     1.29 .40189E+02
     12.31     1.58    0.00     4.0 0.309E+00   0.30     1.30 .41084E+02
     12.48     1.59    0.00     4.0 0.307E+00   0.30     1.32 .41988E+02
     12.73     1.59    0.00     4.1 0.305E+00   0.30     1.34 .43360E+02
     12.90     1.59    0.00     4.1 0.303E+00   0.30     1.35 .44287E+02
     12.98     1.59    0.00     4.1 0.303E+00   0.30     1.36 .44753E+02
     13.15     1.59    0.00     4.1 0.301E+00   0.30     1.38 .45693E+02
     13.32     1.60    0.00     4.1 0.299E+00   0.30     1.39 .46642E+02
     13.57     1.60    0.00     4.2 0.297E+00   0.30     1.41 .48083E+02
     13.74     1.60    0.00     4.2 0.295E+00   0.30     1.42 .49054E+02
     13.82     1.60    0.00     4.2 0.294E+00   0.30     1.43 .49543E+02
     13.99     1.60    0.00     4.2 0.293E+00   0.30     1.45 .50528E+02
     14.16     1.60    0.00     4.3 0.291E+00   0.30     1.46 .51522E+02
     14.41     1.60    0.00     4.3 0.288E+00   0.30     1.48 .53030E+02
     14.58     1.61    0.00     4.3 0.287E+00   0.30     1.49 .54046E+02
     14.66     1.61    0.00     4.3 0.286E+00   0.30     1.50 .54558E+02
     14.83     1.61    0.00     4.4 0.284E+00   0.30     1.51 .55587E+02
     15.00     1.61    0.00     4.4 0.282E+00   0.30     1.53 .56626E+02
     15.25     1.61    0.00     4.4 0.279E+00   0.30     1.55 .58200E+02
     15.42     1.61    0.00     4.5 0.277E+00   0.30     1.56 .59261E+02
     15.50     1.61    0.00     4.5 0.276E+00   0.30     1.57 .59795E+02
     15.67     1.61    0.00     4.5 0.274E+00   0.30     1.58 .60869E+02
     15.93     1.61    0.00     4.6 0.271E+00   0.30     1.60 .62497E+02
     16.09     1.61    0.00     4.6 0.269E+00   0.30     1.61 .63593E+02
     16.26     1.61    0.00     4.6 0.267E+00   0.30     1.63 .64698E+02
     16.43     1.61    0.00     4.7 0.265E+00   0.30     1.64 .65811E+02
  Maximum lateral extent of recirculation bubble.
     16.51     1.61    0.00     4.7 0.264E+00   0.30     1.65 .66372E+02
 End of RECIRCULATION BUBBLE for shoreline-attached jet motion.
   Dilution in recirculation bubble =    5.5
   Corresponding concentration      =    0.225E+00
 Cumulative travel time =          66.3715 sec  (    0.02 hrs)

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
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** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  2.31 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and INTERNAL HYDRAULIC JUMPS.

 Some lateral bank/shore interaction occurs at end othe near-field.

 In the next prediction module, the jet/plume centerline will be set
   to follow the bank/shore.
-----------------------------------------------------------------------------
BEGIN MOD341: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH         TT
     16.51     0.00    0.00     4.7 0.264E+00   0.40     7.62 .66372E+02
     16.59    -0.00    0.00     4.7 0.264E+00   0.40     7.66 .67636E+02
     16.67    -0.00    0.00     4.7 0.264E+00   0.40     7.70 .68901E+02
     16.74    -0.00    0.00     4.7 0.263E+00   0.40     7.73 .70166E+02
     16.82    -0.00    0.00     4.7 0.263E+00   0.39     7.77 .71431E+02
     16.89    -0.00    0.00     4.7 0.263E+00   0.39     7.81 .72696E+02
     16.97    -0.00    0.00     4.7 0.262E+00   0.39     7.84 .73961E+02
     17.05    -0.00    0.00     4.7 0.262E+00   0.39     7.88 .75226E+02
     17.12    -0.00    0.00     4.7 0.262E+00   0.39     7.92 .76491E+02
     17.20    -0.00    0.00     4.7 0.261E+00   0.39     7.95 .77756E+02
     17.27    -0.00    0.00     4.8 0.261E+00   0.39     7.99 .79021E+02
     17.35    -0.00    0.00     4.8 0.260E+00   0.39     8.03 .80286E+02
     17.42    -0.00    0.00     4.8 0.260E+00   0.38     8.06 .81551E+02
     17.50    -0.00    0.00     4.8 0.260E+00   0.38     8.10 .82815E+02
     17.58    -0.00    0.00     4.8 0.259E+00   0.38     8.14 .84080E+02
     17.65    -0.00    0.00     4.8 0.259E+00   0.38     8.17 .85345E+02
     17.73    -0.00    0.00     4.8 0.259E+00   0.38     8.21 .86610E+02
     17.80    -0.00    0.00     4.8 0.258E+00   0.38     8.24 .87875E+02
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17.88	-0.00	0.00	4.8	0.258E+00	0.38	8.28	.89140E+02
17.96	-0.00	0.00	4.8	0.258E+00	0.38	8.32	.90405E+02
18.03	-0.00	0.00	4.8	0.257E+00	0.37	8.35	.91670E+02
18.11	-0.00	0.00	4.8	0.257E+00	0.37	8.39	.92935E+02
18.18	-0.00	0.00	4.8	0.257E+00	0.37	8.42	.94200E+02
18.26	-0.00	0.00	4.8	0.256E+00	0.37	8.46	.95465E+02
18.34	-0.00	0.00	4.8	0.256E+00	0.37	8.49	.96730E+02
18.41	-0.00	0.00	4.8	0.256E+00	0.37	8.53	.97995E+02
18.49	-0.00	0.00	4.8	0.255E+00	0.37	8.57	.99259E+02
18.56	-0.00	0.00	4.9	0.255E+00	0.37	8.60	.10052E+03
18.64	-0.00	0.00	4.9	0.255E+00	0.37	8.64	.10179E+03
18.71	-0.00	0.00	4.9	0.254E+00	0.36	8.67	.10305E+03
18.79	-0.00	0.00	4.9	0.254E+00	0.36	8.71	.10432E+03
18.87	-0.00	0.00	4.9	0.254E+00	0.36	8.74	.10558E+03
18.94	-0.00	0.00	4.9	0.254E+00	0.36	8.78	.10685E+03
19.02	-0.00	0.00	4.9	0.253E+00	0.36	8.81	.10811E+03
19.09	-0.00	0.00	4.9	0.253E+00	0.36	8.85	.10938E+03
19.17	-0.00	0.00	4.9	0.253E+00	0.36	8.88	.11064E+03
19.25	-0.00	0.00	4.9	0.252E+00	0.36	8.91	.11191E+03
19.32	-0.00	0.00	4.9	0.252E+00	0.36	8.95	.11317E+03
19.40	-0.00	0.00	4.9	0.252E+00	0.36	8.98	.11444E+03
19.47	-0.00	0.00	4.9	0.251E+00	0.35	9.02	.11570E+03
19.55	-0.00	0.00	4.9	0.251E+00	0.35	9.05	.11697E+03
19.63	-0.00	0.00	4.9	0.251E+00	0.35	9.09	.11823E+03
19.70	-0.00	0.00	4.9	0.251E+00	0.35	9.12	.11950E+03
19.78	-0.00	0.00	4.9	0.250E+00	0.35	9.16	.12076E+03
19.85	-0.00	0.00	4.9	0.250E+00	0.35	9.19	.12203E+03
19.93	-0.00	0.00	5.0	0.250E+00	0.35	9.22	.12329E+03
20.00	-0.00	0.00	5.0	0.249E+00	0.35	9.26	.12456E+03
20.08	-0.00	0.00	5.0	0.249E+00	0.35	9.29	.12582E+03
20.16	-0.00	0.00	5.0	0.249E+00	0.35	9.32	.12709E+03
20.23	-0.00	0.00	5.0	0.248E+00	0.35	9.36	.12835E+03
20.31	-0.00	0.00	5.0	0.248E+00	0.34	9.39	.12962E+03
20.38	-0.00	0.00	5.0	0.248E+00	0.34	9.43	.13088E+03
20.46	-0.00	0.00	5.0	0.248E+00	0.34	9.46	.13215E+03
20.54	-0.00	0.00	5.0	0.247E+00	0.34	9.49	.13341E+03
20.61	-0.00	0.00	5.0	0.247E+00	0.34	9.53	.13468E+03
20.69	-0.00	0.00	5.0	0.247E+00	0.34	9.56	.13594E+03
20.76	-0.00	0.00	5.0	0.247E+00	0.34	9.59	.13721E+03
20.84	-0.00	0.00	5.0	0.246E+00	0.34	9.63	.13847E+03
20.92	-0.00	0.00	5.0	0.246E+00	0.34	9.66	.13974E+03
20.99	-0.00	0.00	5.0	0.246E+00	0.34	9.69	.14100E+03
21.07	-0.00	0.00	5.0	0.245E+00	0.34	9.73	.14227E+03
21.14	-0.00	0.00	5.0	0.245E+00	0.34	9.76	.14353E+03
21.22	-0.00	0.00	5.0	0.245E+00	0.33	9.79	.14480E+03
21.30	-0.00	0.00	5.0	0.245E+00	0.33	9.82	.14606E+03
21.37	-0.00	0.00	5.1	0.244E+00	0.33	9.86	.14733E+03
21.45	-0.00	0.00	5.1	0.244E+00	0.33	9.89	.14859E+03
21.52	-0.00	0.00	5.1	0.244E+00	0.33	9.92	.14986E+03
21.60	-0.00	0.00	5.1	0.244E+00	0.33	9.96	.15112E+03
21.67	-0.00	0.00	5.1	0.243E+00	0.33	9.99	.15239E+03
21.75	-0.00	0.00	5.1	0.243E+00	0.33	10.02	.15365E+03
21.83	-0.00	0.00	5.1	0.243E+00	0.33	10.05	.15492E+03
21.90	-0.00	0.00	5.1	0.243E+00	0.33	10.09	.15618E+03
21.98	-0.00	0.00	5.1	0.242E+00	0.33	10.12	.15745E+03
22.05	-0.00	0.00	5.1	0.242E+00	0.33	10.15	.15871E+03
22.13	-0.00	0.00	5.1	0.242E+00	0.33	10.18	.15998E+03
22.21	-0.00	0.00	5.1	0.241E+00	0.33	10.22	.16124E+03
22.28	-0.00	0.00	5.1	0.241E+00	0.32	10.25	.16251E+03
22.36	-0.00	0.00	5.1	0.241E+00	0.32	10.28	.16377E+03
22.43	-0.00	0.00	5.1	0.241E+00	0.32	10.31	.16504E+03
22.51	-0.00	0.00	5.1	0.240E+00	0.32	10.34	.16630E+03
22.59	-0.00	0.00	5.1	0.240E+00	0.32	10.38	.16757E+03
22.66	-0.00	0.00	5.1	0.240E+00	0.32	10.41	.16883E+03
22.74	-0.00	0.00	5.1	0.240E+00	0.32	10.44	.17010E+03
22.81	-0.00	0.00	5.1	0.239E+00	0.32	10.47	.17136E+03
22.89	-0.00	0.00	5.2	0.239E+00	0.32	10.50	.17262E+03
22.96	-0.00	0.00	5.2	0.239E+00	0.32	10.54	.17389E+03
23.04	-0.00	0.00	5.2	0.239E+00	0.32	10.57	.17515E+03
23.12	-0.00	0.00	5.2	0.238E+00	0.32	10.60	.17642E+03
23.19	-0.00	0.00	5.2	0.238E+00	0.32	10.63	.17768E+03
23.27	-0.00	0.00	5.2	0.238E+00	0.32	10.66	.17895E+03
23.34	-0.00	0.00	5.2	0.238E+00	0.32	10.69	.18021E+03
23.42	-0.00	0.00	5.2	0.237E+00	0.31	10.72	.18148E+03
23.50	-0.00	0.00	5.2	0.237E+00	0.31	10.76	.18274E+03
23.57	-0.00	0.00	5.2	0.237E+00	0.31	10.79	.18401E+03
23.65	-0.00	0.00	5.2	0.237E+00	0.31	10.82	.18527E+03
23.72	-0.00	0.00	5.2	0.237E+00	0.31	10.85	.18654E+03
23.80	-0.00	0.00	5.2	0.236E+00	0.31	10.88	.18780E+03
23.88	-0.00	0.00	5.2	0.236E+00	0.31	10.91	.18907E+03
23.95	-0.00	0.00	5.2	0.236E+00	0.31	10.94	.19033E+03
24.03	-0.00	0.00	5.2	0.236E+00	0.31	10.97	.19160E+03
24.10	-0.00	0.00	5.2	0.235E+00	0.31	11.00	.19286E+03

Cumulative travel time = 192.8637 sec (0.05 hrs)
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

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BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.529E-03 m^2/s
  Horizontal diffusivity (initial value) = 0.132E-02 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
     24.10     0.00    0.00     5.2 0.235E+00   0.31    11.00 .19286E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.220E+00 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
     38.86     0.00    0.00     6.8 0.179E+00   0.40    11.00 .43885E+03
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
   NO FURTHER CHANGES with downstream direction.
     53.62    -0.00    0.00     6.8 0.177E+00   0.40    11.00 .68483E+03
     68.38    -0.00    0.00     6.8 0.174E+00   0.40    11.00 .93081E+03
     83.14    -0.00    0.00     6.8 0.172E+00   0.40    11.00 .11768E+04
     97.90    -0.00    0.00     6.8 0.169E+00   0.40    11.00 .14228E+04
    112.66    -0.00    0.00     6.8 0.167E+00   0.40    11.00 .16688E+04
    127.42    -0.00    0.00     6.8 0.165E+00   0.40    11.00 .19147E+04
    142.18    -0.00    0.00     6.8 0.162E+00   0.40    11.00 .21607E+04
    156.93    -0.00    0.00     6.8 0.160E+00   0.40    11.00 .24067E+04
    171.69    -0.00    0.00     6.8 0.158E+00   0.40    11.00 .26527E+04
    186.45    -0.00    0.00     6.8 0.155E+00   0.40    11.00 .28987E+04
    201.21    -0.00    0.00     6.8 0.153E+00   0.40    11.00 .31447E+04
    215.97    -0.00    0.00     6.8 0.151E+00   0.40    11.00 .33906E+04
    230.73    -0.00    0.00     6.8 0.149E+00   0.40    11.00 .36366E+04
    245.49    -0.00    0.00     6.8 0.147E+00   0.40    11.00 .38826E+04
    260.25    -0.00    0.00     6.8 0.145E+00   0.40    11.00 .41286E+04
    275.01    -0.00    0.00     6.8 0.143E+00   0.40    11.00 .43746E+04
    289.76    -0.00    0.00     6.8 0.141E+00   0.40    11.00 .46206E+04
    304.52    -0.00    0.00     6.8 0.139E+00   0.40    11.00 .48665E+04
    319.28    -0.00    0.00     6.8 0.137E+00   0.40    11.00 .51125E+04
    334.04    -0.00    0.00     6.8 0.135E+00   0.40    11.00 .53585E+04
    348.80    -0.00    0.00     6.8 0.133E+00   0.40    11.00 .56045E+04
    363.56    -0.00    0.00     6.8 0.131E+00   0.40    11.00 .58505E+04
    378.32    -0.00    0.00     6.8 0.129E+00   0.40    11.00 .60965E+04
    393.08    -0.00    0.00     6.8 0.127E+00   0.40    11.00 .63424E+04
    407.84    -0.00    0.00     6.8 0.126E+00   0.40    11.00 .65884E+04
    422.60    -0.00    0.00     6.8 0.124E+00   0.40    11.00 .68344E+04
    437.35    -0.00    0.00     6.8 0.122E+00   0.40    11.00 .70804E+04
    452.11    -0.00    0.00     6.8 0.120E+00   0.40    11.00 .73264E+04
    466.87    -0.00    0.00     6.8 0.119E+00   0.40    11.00 .75723E+04
    481.63    -0.00    0.00     6.8 0.117E+00   0.40    11.00 .78183E+04
    496.39    -0.00    0.00     6.8 0.115E+00   0.40    11.00 .80643E+04
    511.15    -0.00    0.00     6.8 0.114E+00   0.40    11.00 .83103E+04
    525.91    -0.00    0.00     6.8 0.112E+00   0.40    11.00 .85563E+04
    540.67    -0.00    0.00     6.8 0.110E+00   0.40    11.00 .88023E+04
    555.43    -0.00    0.00     6.8 0.109E+00   0.40    11.00 .90482E+04
    570.19    -0.00    0.00     6.8 0.107E+00   0.40    11.00 .92942E+04
    584.94    -0.00    0.00     6.8 0.106E+00   0.40    11.00 .95402E+04
    599.70    -0.00    0.00     6.8 0.104E+00   0.40    11.00 .97862E+04
    614.46    -0.00    0.00     6.8 0.103E+00   0.40    11.00 .10032E+05
    629.22    -0.00    0.00     6.8 0.101E+00   0.40    11.00 .10278E+05
    643.98    -0.00    0.00     6.8 0.100E+00   0.40    11.00 .10524E+05
    658.74    -0.00    0.00     6.8 0.986E-01   0.40    11.00 .10770E+05
    673.50    -0.00    0.00     6.8 0.972E-01   0.40    11.00 .11016E+05
    688.26    -0.00    0.00     6.8 0.958E-01   0.40    11.00 .11262E+05
    703.02    -0.00    0.00     6.8 0.944E-01   0.40    11.00 .11508E+05
    717.77    -0.00    0.00     6.8 0.931E-01   0.40    11.00 .11754E+05
    732.53    -0.00    0.00     6.8 0.918E-01   0.40    11.00 .12000E+05
    747.29    -0.00    0.00     6.8 0.905E-01   0.40    11.00 .12246E+05
    762.05    -0.00    0.00     6.8 0.892E-01   0.40    11.00 .12492E+05
    776.81    -0.00    0.00     6.8 0.880E-01   0.40    11.00 .12738E+05
    791.57    -0.00    0.00     6.8 0.867E-01   0.40    11.00 .12984E+05
    806.33    -0.00    0.00     6.8 0.855E-01   0.40    11.00 .13230E+05
    821.09    -0.00    0.00     6.8 0.843E-01   0.40    11.00 .13476E+05
    835.85    -0.00    0.00     6.8 0.831E-01   0.40    11.00 .13722E+05
    850.61    -0.00    0.00     6.8 0.819E-01   0.40    11.00 .13968E+05
    865.36    -0.00    0.00     6.8 0.808E-01   0.40    11.00 .14214E+05
    880.12    -0.00    0.00     6.8 0.796E-01   0.40    11.00 .14460E+05
    894.88    -0.00    0.00     6.8 0.785E-01   0.40    11.00 .14706E+05
    909.64    -0.00    0.00     6.8 0.774E-01   0.40    11.00 .14952E+05
    924.40    -0.00    0.00     6.8 0.763E-01   0.40    11.00 .15198E+05
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    939.16    -0.00    0.00     6.8 0.752E-01   0.40    11.00 .15444E+05
    953.92    -0.00    0.00     6.8 0.741E-01   0.40    11.00 .15690E+05
    968.68    -0.00    0.00     6.8 0.731E-01   0.40    11.00 .15936E+05
    983.44    -0.00    0.00     6.8 0.721E-01   0.40    11.00 .16182E+05
    998.20    -0.00    0.00     6.8 0.710E-01   0.40    11.00 .16428E+05
   1012.95    -0.00    0.00     6.8 0.700E-01   0.40    11.00 .16674E+05
   1027.71    -0.00    0.00     6.8 0.691E-01   0.40    11.00 .16920E+05
   1042.47    -0.00    0.00     6.8 0.681E-01   0.40    11.00 .17166E+05
   1057.23    -0.00    0.00     6.8 0.671E-01   0.40    11.00 .17412E+05
   1071.99    -0.00    0.00     6.8 0.662E-01   0.40    11.00 .17658E+05
   1086.75    -0.00    0.00     6.8 0.652E-01   0.40    11.00 .17904E+05
   1101.51    -0.00    0.00     6.8 0.643E-01   0.40    11.00 .18150E+05
   1116.27    -0.00    0.00     6.8 0.634E-01   0.40    11.00 .18396E+05
   1131.03    -0.00    0.00     6.8 0.625E-01   0.40    11.00 .18642E+05
   1145.78    -0.00    0.00     6.8 0.616E-01   0.40    11.00 .18888E+05
   1160.54    -0.00    0.00     6.8 0.607E-01   0.40    11.00 .19134E+05
   1175.30    -0.00    0.00     6.8 0.599E-01   0.40    11.00 .19380E+05
   1190.06    -0.00    0.00     6.8 0.590E-01   0.40    11.00 .19625E+05
   1204.82    -0.00    0.00     6.8 0.582E-01   0.40    11.00 .19871E+05
   1219.58    -0.00    0.00     6.8 0.574E-01   0.40    11.00 .20117E+05
   1234.34    -0.00    0.00     6.8 0.566E-01   0.40    11.00 .20363E+05
   1249.10    -0.00    0.00     6.8 0.558E-01   0.40    11.00 .20609E+05
   1263.86    -0.00    0.00     6.8 0.550E-01   0.40    11.00 .20855E+05
   1278.61    -0.00    0.00     6.8 0.542E-01   0.40    11.00 .21101E+05
   1293.37    -0.00    0.00     6.8 0.534E-01   0.40    11.00 .21347E+05
   1308.13    -0.00    0.00     6.8 0.527E-01   0.40    11.00 .21593E+05
   1322.89    -0.00    0.00     6.8 0.519E-01   0.40    11.00 .21839E+05
   1337.65    -0.00    0.00     6.8 0.512E-01   0.40    11.00 .22085E+05
   1352.41    -0.00    0.00     6.8 0.505E-01   0.40    11.00 .22331E+05
   1367.17    -0.00    0.00     6.8 0.498E-01   0.40    11.00 .22577E+05
   1381.93    -0.00    0.00     6.8 0.491E-01   0.40    11.00 .22823E+05
   1396.69    -0.00    0.00     6.8 0.484E-01   0.40    11.00 .23069E+05
   1411.45    -0.00    0.00     6.8 0.477E-01   0.40    11.00 .23315E+05
   1426.20    -0.00    0.00     6.8 0.470E-01   0.40    11.00 .23561E+05
   1440.96    -0.00    0.00     6.8 0.464E-01   0.40    11.00 .23807E+05
   1455.72    -0.00    0.00     6.8 0.457E-01   0.40    11.00 .24053E+05
   1470.48    -0.00    0.00     6.8 0.451E-01   0.40    11.00 .24299E+05
   1485.24    -0.00    0.00     6.8 0.444E-01   0.40    11.00 .24545E+05
   1500.00    -0.00    0.00     6.8 0.438E-01   0.40    11.00 .24791E+05
 Cumulative travel time =       24791.1406 sec  (    6.89 hrs)

 Simulation limit based on maximum specified distance =   1500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX3: Buoyant Surface Discharges                    End of Prediction File
33333333333333333333333333333333333333333333333333333333333333333333333333333333
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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
               Subsystem CORMIX2: Multiport Diffuser Discharges
                             CORMIX Version 10.0GT
                     HYDRO2 Version 10.0.0.0 July 2016
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   West Credit River
 Design case:       Erin WWTP - 7172
 FILE NAME:         C:\...IX\Erin WWTP-3380-diffuser vertical-good-side.prd
 Time stamp:        11/10/2016--11:56:19

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     11.00  AS    =      4.40  QA    =      0.23  ICHREG= 3
 HA    =      0.40  HD    =      0.40
 UA    =      0.051 F     =      0.130 USTAR =0.6529E-02
 UW    =      2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  997.9542

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= alternating_parallel
 BANK  =  RIGHT     DISTB =      0.00  YB1   =      0.50  YB2   =      0.50
 LD    =      5.00  NOPEN =   10       SPAC  =      0.56
 D0    =      0.050 A0    =      0.002 H0    =      0.00  SUB0  =      0.40
 D0INP =      0.050 CR0   =      1.000
 Nozzle/port arrangement:   near_vertical_discharge
 GAMMA =      0.00  THETA =     90.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      1.986 Q0    =      0.039 Q0A   =0.3900E-01
 RHO0  =  998.4062  DRHO0 =-.4520E+00  GP0   =-.4442E-02
 C0    =0.1245E+01  CUNITS=  mg/l
 IPOLL =  2         KS    =0.0000E+00  KD    =0.5787E-04

DIFFUSER PARAMETERS WITH IMAGE EFFECTS (metric units)
 The bank/shore proximity effect is accounted for by the following flow
 variables and definitions of length scales and parameters.
 LD    =      5.00  Q0    =      0.078 Q0A    =0.3900E-01

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3120E-01  m0    =0.1549E-01  j0    =-.3465E-04  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.016 lM    =     14.54  lm    =     11.85
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.7800E-01  M0    =0.7746E-01  J0    =-.1732E-03
 Associated 3-d length scales (meters)
 LQ    =      0.04  LM    =     11.16  Lm    =      7.70  Lb    =      2.59
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    475.55  FRD0  =    133.27  R     =     38.84  PL    =  140.00
 (slot)             (port/nozzle)


FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU14  2
 2  Applicable layer depth HS =     0.40  2
 2  Limiting Dilution S =QA/Q0=     3.88  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1245E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2200E+00
 REGMZ =  0
 XINT  =    200.00  XMAX  =    200.00

X-Y-Z COORDINATE SYSTEM:
  because of bank/shore proximity, the ORIGIN is located directly
   at the RIGHT bank/shore.
  the bank/shore acts as a plane of symmetry for the predicted
  plume geometry.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
```

```
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00    0.00     1.0 0.125E+01   0.00     2.50     1.986   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
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-----------------------------------------------------------------------------------------------
BEGIN MOD234: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 The MIXING of this alternating diffuser is somewhat REDUCED
   due to its PARALLEL ALIGNMENT.
 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =   1.41) occurs in a limited region (horizontal extent
   =    3.00 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.125E+01   0.00     2.50   .00000E+00

  Control volume outflow:
       X        Y       Z        S       C       BV       BH        TT
      3.00     0.00    0.20     1.4 0.880E+00   0.40     1.00   .00000E+00

END OF MOD234: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD234a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length              =       0.26 m
        X-position of upstream stagnation point =      2.74 m
        Thickness in intrusion region          =       0.40 m
        Half-width at downstream end           =       2.86 m
        Thickness at downstream end            =       0.38 m

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      3.00     0.00    0.20     1.4 0.880E+00   0.40     1.00   .00000E+00

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL       TT
      2.74     0.00    0.00  9999.9 0.000E+00   0.00     0.00    0.00    0.00   .28011E+02
      2.77     0.00    0.00     3.1 0.397E+00   0.40     0.41    0.40    0.00   .00000E+00
      2.94     0.00    0.00     1.5 0.852E+00   0.40     0.98    0.40    0.00   .00000E+00
      3.11     0.00    0.00     1.4 0.880E+00   0.38     1.93    0.38    0.00   .20797E+01
      3.27     0.00    0.00     1.4 0.878E+00   0.38     2.10    0.38    0.00   .53212E+01
      3.44     0.00    0.00     1.4 0.875E+00   0.38     2.24    0.38    0.00   .85626E+01
      3.60     0.00    0.00     1.4 0.872E+00   0.38     2.37    0.38    0.00   .11804E+02
      3.77     0.00    0.00     1.4 0.870E+00   0.38     2.48    0.38    0.00   .15045E+02
      3.94     0.00    0.00     1.4 0.868E+00   0.38     2.59    0.38    0.00   .18287E+02
      4.10     0.00    0.00     1.4 0.866E+00   0.38     2.68    0.38    0.00   .21528E+02
      4.27     0.00    0.00     1.4 0.866E+00   0.38     2.78    0.38    0.00   .24770E+02
      4.43     0.00    0.00     1.4 0.865E+00   0.38     2.86    0.38    0.00   .28011E+02
 Cumulative travel time =          28.0112 sec  (    0.01 hrs)

END OF MOD234a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
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** End of NEAR-FIELD REGION (NFR) **

 Recall that the plume is symmetric to the bank/shore on which the centerline
   (X-axis) is located.
-----------------------------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL       TT
```

4.43	0.00	0.00	1.4	0.865E+00	0.38	2.86	0.38	0.00	.28011E+02
5.10	0.00	0.00	1.5	0.849E+00	0.37	3.05	0.37	0.00	.39197E+02
5.77	0.00	0.00	1.5	0.835E+00	0.35	3.23	0.35	0.00	.50382E+02
6.45	0.00	0.00	1.5	0.822E+00	0.34	3.40	0.34	0.00	.61568E+02
7.12	0.00	0.00	1.5	0.810E+00	0.33	3.56	0.33	0.00	.72754E+02
7.79	0.00	0.00	1.5	0.799E+00	0.32	3.71	0.32	0.00	.83939E+02
8.46	0.00	0.00	1.6	0.789E+00	0.31	3.86	0.31	0.00	.95125E+02
9.13	0.00	0.00	1.6	0.779E+00	0.30	4.00	0.30	0.00	.10631E+03
9.80	0.00	0.00	1.6	0.770E+00	0.30	4.14	0.30	0.00	.11750E+03
10.47	0.00	0.00	1.6	0.761E+00	0.29	4.27	0.29	0.00	.12868E+03
11.14	0.00	0.00	1.6	0.752E+00	0.28	4.40	0.28	0.00	.13987E+03
11.81	0.00	0.00	1.7	0.744E+00	0.28	4.52	0.28	0.00	.15105E+03
12.49	0.00	0.00	1.7	0.736E+00	0.28	4.64	0.28	0.00	.16224E+03
13.16	0.00	0.00	1.7	0.728E+00	0.27	4.76	0.27	0.00	.17342E+03
13.83	0.00	0.00	1.7	0.721E+00	0.27	4.88	0.27	0.00	.18461E+03
14.50	0.00	0.00	1.7	0.713E+00	0.26	4.99	0.26	0.00	.19580E+03
15.17	0.00	0.00	1.7	0.706E+00	0.26	5.10	0.26	0.00	.20698E+03
15.84	0.00	0.00	1.8	0.699E+00	0.26	5.20	0.26	0.00	.21817E+03
16.51	0.00	0.00	1.8	0.692E+00	0.26	5.31	0.26	0.00	.22935E+03
17.18	0.00	0.00	1.8	0.685E+00	0.25	5.41	0.25	0.00	.24054E+03
17.86	0.00	0.00	1.8	0.678E+00	0.25	5.51	0.25	0.00	.25172E+03
18.53	0.00	0.00	1.8	0.671E+00	0.25	5.61	0.25	0.00	.26291E+03
19.20	0.00	0.00	1.8	0.665E+00	0.25	5.71	0.25	0.00	.27409E+03
19.87	0.00	0.00	1.9	0.658E+00	0.24	5.80	0.24	0.00	.28528E+03
20.54	0.00	0.00	1.9	0.651E+00	0.24	5.90	0.24	0.00	.29647E+03
21.21	0.00	0.00	1.9	0.645E+00	0.24	5.99	0.24	0.00	.30765E+03
21.88	0.00	0.00	1.9	0.639E+00	0.24	6.08	0.24	0.00	.31884E+03
22.55	0.00	0.00	1.9	0.632E+00	0.24	6.17	0.24	0.00	.33002E+03
23.22	0.00	0.00	1.9	0.626E+00	0.24	6.25	0.24	0.00	.34121E+03
23.90	0.00	0.00	2.0	0.620E+00	0.24	6.34	0.24	0.00	.35239E+03
24.57	0.00	0.00	2.0	0.614E+00	0.24	6.43	0.24	0.00	.36358E+03
25.24	0.00	0.00	2.0	0.608E+00	0.23	6.51	0.23	0.00	.37477E+03
25.91	0.00	0.00	2.0	0.602E+00	0.23	6.59	0.23	0.00	.38595E+03
26.58	0.00	0.00	2.0	0.596E+00	0.23	6.68	0.23	0.00	.39714E+03
27.25	0.00	0.00	2.1	0.590E+00	0.23	6.76	0.23	0.00	.40832E+03
27.92	0.00	0.00	2.1	0.584E+00	0.23	6.84	0.23	0.00	.41951E+03
28.59	0.00	0.00	2.1	0.578E+00	0.23	6.92	0.23	0.00	.43069E+03
29.26	0.00	0.00	2.1	0.572E+00	0.23	7.00	0.23	0.00	.44188E+03
29.94	0.00	0.00	2.1	0.567E+00	0.23	7.07	0.23	0.00	.45306E+03
30.61	0.00	0.00	2.2	0.561E+00	0.23	7.15	0.23	0.00	.46425E+03
31.28	0.00	0.00	2.2	0.555E+00	0.23	7.23	0.23	0.00	.47544E+03
31.95	0.00	0.00	2.2	0.550E+00	0.23	7.30	0.23	0.00	.48662E+03
32.62	0.00	0.00	2.2	0.544E+00	0.23	7.38	0.23	0.00	.49781E+03
33.29	0.00	0.00	2.2	0.538E+00	0.23	7.45	0.23	0.00	.50899E+03
33.96	0.00	0.00	2.3	0.533E+00	0.23	7.52	0.23	0.00	.52018E+03
34.63	0.00	0.00	2.3	0.527E+00	0.23	7.60	0.23	0.00	.53136E+03
35.30	0.00	0.00	2.3	0.522E+00	0.23	7.67	0.23	0.00	.54255E+03
35.98	0.00	0.00	2.3	0.517E+00	0.23	7.74	0.23	0.00	.55374E+03
36.65	0.00	0.00	2.4	0.511E+00	0.23	7.81	0.23	0.00	.56492E+03
37.32	0.00	0.00	2.4	0.506E+00	0.23	7.88	0.23	0.00	.57611E+03
37.99	0.00	0.00	2.4	0.501E+00	0.23	7.95	0.23	0.00	.58729E+03
38.66	0.00	0.00	2.4	0.496E+00	0.23	8.02	0.23	0.00	.59848E+03
39.33	0.00	0.00	2.5	0.491E+00	0.23	8.09	0.23	0.00	.60966E+03
40.00	0.00	0.00	2.5	0.485E+00	0.23	8.16	0.23	0.00	.62085E+03
40.67	0.00	0.00	2.5	0.480E+00	0.23	8.23	0.23	0.00	.63203E+03
41.34	0.00	0.00	2.5	0.475E+00	0.23	8.29	0.23	0.00	.64322E+03
42.02	0.00	0.00	2.5	0.470E+00	0.23	8.36	0.23	0.00	.65441E+03
42.69	0.00	0.00	2.6	0.465E+00	0.23	8.43	0.23	0.00	.66559E+03
43.36	0.00	0.00	2.6	0.461E+00	0.23	8.49	0.23	0.00	.67678E+03
44.03	0.00	0.00	2.6	0.456E+00	0.23	8.56	0.23	0.00	.68796E+03
44.70	0.00	0.00	2.7	0.451E+00	0.23	8.62	0.23	0.00	.69915E+03
45.37	0.00	0.00	2.7	0.446E+00	0.24	8.69	0.24	0.00	.71033E+03
46.04	0.00	0.00	2.7	0.441E+00	0.24	8.75	0.24	0.00	.72152E+03
46.71	0.00	0.00	2.7	0.437E+00	0.24	8.82	0.24	0.00	.73271E+03
47.39	0.00	0.00	2.8	0.432E+00	0.24	8.88	0.24	0.00	.74389E+03
48.06	0.00	0.00	2.8	0.428E+00	0.24	8.94	0.24	0.00	.75508E+03
48.73	0.00	0.00	2.8	0.423E+00	0.24	9.01	0.24	0.00	.76626E+03
49.40	0.00	0.00	2.8	0.418E+00	0.24	9.07	0.24	0.00	.77745E+03
50.07	0.00	0.00	2.9	0.414E+00	0.24	9.13	0.24	0.00	.78863E+03
50.74	0.00	0.00	2.9	0.410E+00	0.24	9.19	0.24	0.00	.79982E+03
51.41	0.00	0.00	2.9	0.405E+00	0.24	9.25	0.24	0.00	.81101E+03
52.08	0.00	0.00	3.0	0.401E+00	0.24	9.32	0.24	0.00	.82219E+03
52.75	0.00	0.00	3.0	0.397E+00	0.24	9.38	0.24	0.00	.83338E+03
53.43	0.00	0.00	3.0	0.392E+00	0.24	9.44	0.24	0.00	.84456E+03
54.10	0.00	0.00	3.1	0.388E+00	0.25	9.50	0.25	0.00	.85575E+03
54.77	0.00	0.00	3.1	0.384E+00	0.25	9.56	0.25	0.00	.86693E+03
55.44	0.00	0.00	3.1	0.380E+00	0.25	9.62	0.25	0.00	.87812E+03
56.11	0.00	0.00	3.1	0.376E+00	0.25	9.68	0.25	0.00	.88930E+03
56.78	0.00	0.00	3.2	0.372E+00	0.25	9.74	0.25	0.00	.90049E+03
57.45	0.00	0.00	3.2	0.368E+00	0.25	9.80	0.25	0.00	.91168E+03
58.12	0.00	0.00	3.2	0.364E+00	0.25	9.86	0.25	0.00	.92286E+03
58.79	0.00	0.00	3.3	0.360E+00	0.25	9.92	0.25	0.00	.93405E+03
59.47	0.00	0.00	3.3	0.356E+00	0.25	9.98	0.25	0.00	.94523E+03
60.14	0.00	0.00	3.3	0.352E+00	0.25	10.03	0.25	0.00	.95642E+03
60.81	0.00	0.00	3.4	0.349E+00	0.26	10.09	0.26	0.00	.96760E+03
61.48	0.00	0.00	3.4	0.345E+00	0.26	10.15	0.26	0.00	.97879E+03
62.15	0.00	0.00	3.4	0.341E+00	0.26	10.21	0.26	0.00	.98998E+03
62.82	0.00	0.00	3.5	0.337E+00	0.26	10.27	0.26	0.00	.10012E+04
63.49	0.00	0.00	3.5	0.334E+00	0.26	10.32	0.26	0.00	.10123E+04

64.16	0.00	0.00	3.6	0.330E+00	0.26	10.38	0.26	0.00	.10235E+04
64.83	0.00	0.00	3.6	0.327E+00	0.26	10.44	0.26	0.00	.10347E+04
65.51	0.00	0.00	3.6	0.323E+00	0.26	10.50	0.26	0.00	.10459E+04
66.18	0.00	0.00	3.7	0.320E+00	0.26	10.55	0.26	0.00	.10571E+04
66.85	0.00	0.00	3.7	0.316E+00	0.27	10.61	0.27	0.00	.10683E+04
67.52	0.00	0.00	3.7	0.313E+00	0.27	10.67	0.27	0.00	.10795E+04
68.19	0.00	0.00	3.8	0.310E+00	0.27	10.72	0.27	0.00	.10906E+04
68.86	0.00	0.00	3.8	0.306E+00	0.27	10.78	0.27	0.00	.11018E+04
69.53	0.00	0.00	3.9	0.303E+00	0.27	10.84	0.27	0.00	.11130E+04
70.20	0.00	0.00	3.9	0.300E+00	0.27	10.89	0.27	0.00	.11242E+04
70.88	0.00	0.00	3.9	0.297E+00	0.27	10.95	0.27	0.00	.11354E+04
71.55	0.00	0.00	4.0	0.293E+00	0.28	11.00	0.28	0.00	.11466E+04

Cumulative travel time = 1146.5731 sec (0.32 hrs)
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD241: BUOYANT AMBIENT SPREADING

BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.529E-03 m^2/s
Horizontal diffusivity (initial value) = 0.265E-02 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
71.55	0.00	0.00	4.0	0.293E+00	0.28	11.00	0.28	0.00	.11466E+04
72.83	0.00	0.00	4.0	0.291E+00	0.28	11.00	0.28	0.00	.11680E+04
74.12	0.00	0.00	4.0	0.288E+00	0.28	11.00	0.28	0.00	.11894E+04
75.40	0.00	0.00	4.1	0.285E+00	0.28	11.00	0.28	0.00	.12108E+04
76.68	0.00	0.00	4.1	0.282E+00	0.29	11.00	0.29	0.00	.12322E+04
77.97	0.00	0.00	4.2	0.279E+00	0.29	11.00	0.29	0.00	.12536E+04
79.25	0.00	0.00	4.2	0.276E+00	0.29	11.00	0.29	0.00	.12750E+04
80.54	0.00	0.00	4.2	0.273E+00	0.29	11.00	0.29	0.00	.12964E+04
81.82	0.00	0.00	4.3	0.270E+00	0.30	11.00	0.30	0.00	.13178E+04
83.11	0.00	0.00	4.3	0.268E+00	0.30	11.00	0.30	0.00	.13393E+04
84.39	0.00	0.00	4.3	0.265E+00	0.30	11.00	0.30	0.00	.13607E+04
85.68	0.00	0.00	4.4	0.262E+00	0.30	11.00	0.30	0.00	.13821E+04
86.96	0.00	0.00	4.4	0.259E+00	0.31	11.00	0.31	0.00	.14035E+04
88.25	0.00	0.00	4.5	0.256E+00	0.31	11.00	0.31	0.00	.14249E+04
89.53	0.00	0.00	4.5	0.254E+00	0.31	11.00	0.31	0.00	.14463E+04
90.81	0.00	0.00	4.6	0.251E+00	0.32	11.00	0.32	0.00	.14677E+04
92.10	0.00	0.00	4.6	0.248E+00	0.32	11.00	0.32	0.00	.14891E+04
93.38	0.00	0.00	4.6	0.245E+00	0.32	11.00	0.32	0.00	.15105E+04
94.67	0.00	0.00	4.7	0.243E+00	0.33	11.00	0.33	0.00	.15319E+04
95.95	0.00	0.00	4.7	0.240E+00	0.33	11.00	0.33	0.00	.15533E+04
97.24	0.00	0.00	4.8	0.238E+00	0.33	11.00	0.33	0.00	.15748E+04
98.52	0.00	0.00	4.8	0.235E+00	0.33	11.00	0.33	0.00	.15962E+04
99.81	0.00	0.00	4.9	0.232E+00	0.34	11.00	0.34	0.00	.16176E+04
101.09	0.00	0.00	4.9	0.230E+00	0.34	11.00	0.34	0.00	.16390E+04
102.38	0.00	0.00	5.0	0.227E+00	0.35	11.00	0.35	0.00	.16604E+04
103.66	0.00	0.00	5.0	0.225E+00	0.35	11.00	0.35	0.00	.16818E+04
104.94	0.00	0.00	5.1	0.222E+00	0.35	11.00	0.35	0.00	.17032E+04

** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard
or CCC value of 0.220E+00 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality
standard or CCC value.

106.23	0.00	0.00	5.1	0.219E+00	0.36	11.00	0.36	0.00	.17246E+04
107.51	0.00	0.00	5.2	0.217E+00	0.36	11.00	0.36	0.00	.17460E+04
108.80	0.00	0.00	5.2	0.214E+00	0.36	11.00	0.36	0.00	.17674E+04
110.08	0.00	0.00	5.3	0.212E+00	0.37	11.00	0.37	0.00	.17888E+04
111.37	0.00	0.00	5.4	0.210E+00	0.37	11.00	0.37	0.00	.18103E+04
112.65	0.00	0.00	5.4	0.207E+00	0.37	11.00	0.37	0.00	.18317E+04
113.94	0.00	0.00	5.5	0.205E+00	0.38	11.00	0.38	0.00	.18531E+04
115.22	0.00	0.00	5.5	0.202E+00	0.38	11.00	0.38	0.00	.18745E+04
116.50	0.00	0.00	5.6	0.200E+00	0.39	11.00	0.39	0.00	.18959E+04
117.79	0.00	0.00	5.6	0.198E+00	0.39	11.00	0.39	0.00	.19173E+04
119.07	0.00	0.00	5.7	0.195E+00	0.40	11.00	0.40	0.00	.19387E+04
120.36	0.00	0.00	5.8	0.193E+00	0.40	11.00	0.40	0.00	.19601E+04

Plume interacts with SURFACE.
The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
prediction interval.

121.64	0.00	0.00	5.8	0.192E+00	0.40	11.00	0.40	0.00	.19815E+04

Effluent is FULLY MIXED over the entire channel cross-section.
Except for possible far-field decay or reaction processes, there are
NO FURTHER CHANGES with downstream direction.

122.93	0.00	0.00	5.8	0.192E+00	0.40	11.00	0.40	0.00	.20029E+04
124.21	0.00	0.00	5.8	0.192E+00	0.40	11.00	0.40	0.00	.20243E+04

125.50	0.00	0.00	5.8	0.192E+00	0.40	11.00	0.40	0.00	.20458E+04
126.78	0.00	0.00	5.8	0.191E+00	0.40	11.00	0.40	0.00	.20672E+04
128.07	0.00	0.00	5.8	0.191E+00	0.40	11.00	0.40	0.00	.20886E+04
129.35	0.00	0.00	5.8	0.191E+00	0.40	11.00	0.40	0.00	.21100E+04
130.63	0.00	0.00	5.8	0.191E+00	0.40	11.00	0.40	0.00	.21314E+04
131.92	0.00	0.00	5.8	0.190E+00	0.40	11.00	0.40	0.00	.21528E+04
133.20	0.00	0.00	5.8	0.190E+00	0.40	11.00	0.40	0.00	.21742E+04
134.49	0.00	0.00	5.8	0.190E+00	0.40	11.00	0.40	0.00	.21956E+04
135.77	0.00	0.00	5.8	0.190E+00	0.40	11.00	0.40	0.00	.22170E+04
137.06	0.00	0.00	5.8	0.190E+00	0.40	11.00	0.40	0.00	.22384E+04
138.34	0.00	0.00	5.8	0.189E+00	0.40	11.00	0.40	0.00	.22598E+04
139.63	0.00	0.00	5.8	0.189E+00	0.40	11.00	0.40	0.00	.22812E+04
140.91	0.00	0.00	5.8	0.189E+00	0.40	11.00	0.40	0.00	.23027E+04
142.20	0.00	0.00	5.8	0.189E+00	0.40	11.00	0.40	0.00	.23241E+04
143.48	0.00	0.00	5.8	0.188E+00	0.40	11.00	0.40	0.00	.23455E+04
144.76	0.00	0.00	5.8	0.188E+00	0.40	11.00	0.40	0.00	.23669E+04
146.05	0.00	0.00	5.8	0.188E+00	0.40	11.00	0.40	0.00	.23883E+04
147.33	0.00	0.00	5.8	0.188E+00	0.40	11.00	0.40	0.00	.24097E+04
148.62	0.00	0.00	5.8	0.187E+00	0.40	11.00	0.40	0.00	.24311E+04
149.90	0.00	0.00	5.8	0.187E+00	0.40	11.00	0.40	0.00	.24525E+04
151.19	0.00	0.00	5.8	0.187E+00	0.40	11.00	0.40	0.00	.24739E+04
152.47	0.00	0.00	5.8	0.187E+00	0.40	11.00	0.40	0.00	.24953E+04
153.76	0.00	0.00	5.8	0.187E+00	0.40	11.00	0.40	0.00	.25168E+04
155.04	0.00	0.00	5.8	0.186E+00	0.40	11.00	0.40	0.00	.25382E+04
156.33	0.00	0.00	5.8	0.186E+00	0.40	11.00	0.40	0.00	.25596E+04
157.61	0.00	0.00	5.8	0.186E+00	0.40	11.00	0.40	0.00	.25810E+04
158.89	0.00	0.00	5.8	0.186E+00	0.40	11.00	0.40	0.00	.26024E+04
160.18	0.00	0.00	5.8	0.185E+00	0.40	11.00	0.40	0.00	.26238E+04
161.46	0.00	0.00	5.8	0.185E+00	0.40	11.00	0.40	0.00	.26452E+04
162.75	0.00	0.00	5.8	0.185E+00	0.40	11.00	0.40	0.00	.26666E+04
164.03	0.00	0.00	5.8	0.185E+00	0.40	11.00	0.40	0.00	.26880E+04
165.32	0.00	0.00	5.8	0.184E+00	0.40	11.00	0.40	0.00	.27094E+04
166.60	0.00	0.00	5.8	0.184E+00	0.40	11.00	0.40	0.00	.27308E+04
167.89	0.00	0.00	5.8	0.184E+00	0.40	11.00	0.40	0.00	.27522E+04
169.17	0.00	0.00	5.8	0.184E+00	0.40	11.00	0.40	0.00	.27737E+04
170.46	0.00	0.00	5.8	0.184E+00	0.40	11.00	0.40	0.00	.27951E+04
171.74	0.00	0.00	5.8	0.183E+00	0.40	11.00	0.40	0.00	.28165E+04
173.02	0.00	0.00	5.8	0.183E+00	0.40	11.00	0.40	0.00	.28379E+04
174.31	0.00	0.00	5.8	0.183E+00	0.40	11.00	0.40	0.00	.28593E+04
175.59	0.00	0.00	5.8	0.183E+00	0.40	11.00	0.40	0.00	.28807E+04
176.88	0.00	0.00	5.8	0.182E+00	0.40	11.00	0.40	0.00	.29021E+04
178.16	0.00	0.00	5.8	0.182E+00	0.40	11.00	0.40	0.00	.29235E+04
179.45	0.00	0.00	5.8	0.182E+00	0.40	11.00	0.40	0.00	.29449E+04
180.73	0.00	0.00	5.8	0.182E+00	0.40	11.00	0.40	0.00	.29663E+04
182.02	0.00	0.00	5.8	0.181E+00	0.40	11.00	0.40	0.00	.29878E+04
183.30	0.00	0.00	5.8	0.181E+00	0.40	11.00	0.40	0.00	.30092E+04
184.59	0.00	0.00	5.8	0.181E+00	0.40	11.00	0.40	0.00	.30306E+04
185.87	0.00	0.00	5.8	0.181E+00	0.40	11.00	0.40	0.00	.30520E+04
187.15	0.00	0.00	5.8	0.181E+00	0.40	11.00	0.40	0.00	.30734E+04
188.44	0.00	0.00	5.8	0.180E+00	0.40	11.00	0.40	0.00	.30948E+04
189.72	0.00	0.00	5.8	0.180E+00	0.40	11.00	0.40	0.00	.31162E+04
191.01	0.00	0.00	5.8	0.180E+00	0.40	11.00	0.40	0.00	.31376E+04
192.29	0.00	0.00	5.8	0.180E+00	0.40	11.00	0.40	0.00	.31590E+04
193.58	0.00	0.00	5.8	0.179E+00	0.40	11.00	0.40	0.00	.31804E+04
194.86	0.00	0.00	5.8	0.179E+00	0.40	11.00	0.40	0.00	.32018E+04
196.15	0.00	0.00	5.8	0.179E+00	0.40	11.00	0.40	0.00	.32232E+04
197.43	0.00	0.00	5.8	0.179E+00	0.40	11.00	0.40	0.00	.32447E+04
198.72	0.00	0.00	5.8	0.179E+00	0.40	11.00	0.40	0.00	.32661E+04
200.00	0.00	0.00	5.8	0.178E+00	0.40	11.00	0.40	0.00	.32875E+04

Cumulative travel time = 3287.4712 sec (0.91 hrs)

Simulation limit based on maximum specified distance = 200.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX2: Multiport Diffuser Discharges   End of Prediction File

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CORMIX2 PREDICTION FILE:
222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
               Subsystem CORMIX2: Multiport Diffuser Discharges
                             CORMIX Version 10.0GT
                     HYDRO2 Version 10.0.0.0 July 2016
----------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   West Credit River
 Design case:       Erin WWTP - 7172
 FILE NAME:         C:\...IX\Erin WWTP-7172-diffuser vertical-good-side.prd
 Time stamp:        11/10/2016--11:56:46

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =     11.00  AS    =      4.40  QA    =      0.23  ICHREG= 3
 HA    =      0.40  HD    =      0.40
 UA    =      0.051 F     =      0.130 USTAR =0.6529E-02
 UW    =      2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  997.9542

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= alternating_parallel
 BANK  =  RIGHT     DISTB =      0.00  YB1   =      0.50  YB2   =      0.50
 LD    =      5.00  NOPEN =   15       SPAC  =      0.36
 D0    =      0.050 A0    =      0.002 H0    =      0.00  SUB0  =      0.40
 D0INP =      0.050 CR0   =      1.000
 Nozzle/port arrangement:   near_vertical_discharge
 GAMMA =      0.00  THETA =     90.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      2.818 Q0    =      0.083 Q0A   =0.8300E-01
 RHO0  =  998.4062  DRHO0 =-.4520E+00  GP0   =-.4442E-02
 C0    =0.6450E+00  CUNITS=  mg/l
 IPOLL =  2         KS    =0.0000E+00  KD    =0.5787E-04

DIFFUSER PARAMETERS WITH IMAGE EFFECTS (metric units)
 The bank/shore proximity effect is accounted for by the following flow
 variables and definitions of length scales and parameters.
 LD    =      5.00  Q0    =      0.166 Q0A    =0.8300E-01

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.6640E-01  m0    =0.4678E-01  j0    =-.7374E-04  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.024 lM    =     26.52  lm    =     35.78
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.1660E+00  M0    =0.2339E+00  J0    =-.3687E-03
 Associated 3-d length scales (meters)
 LQ    =      0.04  LM    =     17.52  Lm    =     13.38  Lb    =      5.51
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    550.91  FRD0  =    189.09  R     =     55.11  PL    =  140.00
 (slot)             (port/nozzle)


FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU14  2
 2  Applicable layer depth HS =     0.40  2
 2  Limiting Dilution S =QA/Q0=     2.36  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.6450E+00  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2050E+00
 REGMZ =  0
 XINT  =    200.00  XMAX  =    200.00

X-Y-Z COORDINATE SYSTEM:
  because of bank/shore proximity, the ORIGIN is located directly
   at the RIGHT bank/shore.
  the bank/shore acts as a plane of symmetry for the predicted
  plume geometry.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 100 display intervals per module
----------------------------------------------------------------------------------------------
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BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
```

C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	Uc	TT
0.00	0.00	0.00	1.0	0.645E+00	0.00	2.50	2.818	.00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD234: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

The MIXING of this alternating diffuser is somewhat REDUCED
due to its PARALLEL ALIGNMENT.
INITIAL LOCAL VERTICAL INSTABILITY REGION:
Bulk dilution (S = 1.41) occurs in a limited region (horizontal extent
= 3.00 m) surrounding the discharge location.

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.00	0.00	0.00	1.0	0.645E+00	0.00	2.50	.00000E+00

Control volume outflow:

X	Y	Z	S	C	BV	BH	TT
3.00	0.00	0.20	1.4	0.456E+00	0.40	1.00	.00000E+00

END OF MOD234: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

BEGIN MOD234a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

UPSTREAM INTRUSION PROPERTIES:
Upstream intrusion length = 0.55 m
X-position of upstream stagnation point = 2.45 m
Thickness in intrusion region = 0.40 m
Half-width at downstream end = 6.01 m
Thickness at downstream end = 0.39 m

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
3.00	0.00	0.20	1.4	0.456E+00	0.40	1.00	.00000E+00

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
2.45	0.00	0.00	9999.9	0.000E+00	0.00	0.00	0.00	0.00	.58745E+02
2.52	0.00	0.00	3.2	0.205E+00	0.40	0.85	0.40	0.00	.00000E+00
2.87	0.00	0.00	1.5	0.440E+00	0.40	2.06	0.40	0.00	.00000E+00
3.22	0.00	0.00	1.4	0.456E+00	0.39	4.06	0.39	0.00	.42412E+01
3.57	0.00	0.00	1.4	0.455E+00	0.39	4.41	0.39	0.00	.11054E+02
3.91	0.00	0.00	1.4	0.454E+00	0.39	4.70	0.39	0.00	.17867E+02
4.26	0.00	0.00	1.4	0.452E+00	0.39	4.97	0.39	0.00	.24680E+02
4.61	0.00	0.00	1.4	0.451E+00	0.39	5.21	0.39	0.00	.31493E+02
4.96	0.00	0.00	1.4	0.450E+00	0.39	5.43	0.39	0.00	.38306E+02
5.31	0.00	0.00	1.4	0.449E+00	0.39	5.63	0.39	0.00	.45119E+02
5.66	0.00	0.00	1.4	0.449E+00	0.39	5.82	0.39	0.00	.51932E+02
6.00	0.00	0.00	1.4	0.448E+00	0.39	6.01	0.39	0.00	.58745E+02

Cumulative travel time = 58.7450 sec (0.02 hrs)

END OF MOD234a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

** End of NEAR-FIELD REGION (NFR) **

Recall that the plume is symmetric to the bank/shore on which the centerline
(X-axis) is located.

BEGIN MOD241: BUOYANT AMBIENT SPREADING

Plume is ATTACHED to RIGHT bank/shore.
Plume width is now determined from RIGHT bank/shore.

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT

6.00	0.00	0.00	1.4	0.448E+00	0.39	6.01	0.39	0.00	.58745E+02
6.37	0.00	0.00	1.4	0.447E+00	0.38	6.08	0.38	0.00	.63935E+02
6.73	0.00	0.00	1.4	0.445E+00	0.38	6.15	0.38	0.00	.69124E+02
7.09	0.00	0.00	1.4	0.443E+00	0.38	6.22	0.38	0.00	.74314E+02
7.46	0.00	0.00	1.5	0.441E+00	0.38	6.29	0.38	0.00	.79503E+02
7.82	0.00	0.00	1.5	0.440E+00	0.37	6.36	0.37	0.00	.84693E+02
8.18	0.00	0.00	1.5	0.438E+00	0.37	6.43	0.37	0.00	.89883E+02
8.55	0.00	0.00	1.5	0.436E+00	0.37	6.50	0.37	0.00	.95072E+02
8.91	0.00	0.00	1.5	0.435E+00	0.36	6.56	0.36	0.00	.10026E+03
9.27	0.00	0.00	1.5	0.433E+00	0.36	6.63	0.36	0.00	.10545E+03
9.64	0.00	0.00	1.5	0.432E+00	0.36	6.70	0.36	0.00	.11064E+03
10.00	0.00	0.00	1.5	0.430E+00	0.36	6.76	0.36	0.00	.11583E+03
10.36	0.00	0.00	1.5	0.429E+00	0.36	6.82	0.36	0.00	.12102E+03
10.73	0.00	0.00	1.5	0.427E+00	0.35	6.89	0.35	0.00	.12621E+03
11.09	0.00	0.00	1.5	0.426E+00	0.35	6.95	0.35	0.00	.13140E+03
11.45	0.00	0.00	1.5	0.424E+00	0.35	7.01	0.35	0.00	.13659E+03
11.82	0.00	0.00	1.5	0.423E+00	0.35	7.07	0.35	0.00	.14178E+03
12.18	0.00	0.00	1.5	0.421E+00	0.35	7.13	0.35	0.00	.14697E+03
12.54	0.00	0.00	1.5	0.420E+00	0.34	7.19	0.34	0.00	.15216E+03
12.91	0.00	0.00	1.5	0.418E+00	0.34	7.25	0.34	0.00	.15735E+03
13.27	0.00	0.00	1.5	0.417E+00	0.34	7.31	0.34	0.00	.16254E+03
13.63	0.00	0.00	1.5	0.416E+00	0.34	7.37	0.34	0.00	.16773E+03
14.00	0.00	0.00	1.5	0.414E+00	0.34	7.43	0.34	0.00	.17292E+03
14.36	0.00	0.00	1.5	0.413E+00	0.34	7.49	0.34	0.00	.17811E+03
14.72	0.00	0.00	1.6	0.411E+00	0.33	7.55	0.33	0.00	.18330E+03
15.09	0.00	0.00	1.6	0.410E+00	0.33	7.60	0.33	0.00	.18848E+03
15.45	0.00	0.00	1.6	0.409E+00	0.33	7.66	0.33	0.00	.19367E+03
15.81	0.00	0.00	1.6	0.407E+00	0.33	7.71	0.33	0.00	.19886E+03
16.18	0.00	0.00	1.6	0.406E+00	0.33	7.77	0.33	0.00	.20405E+03
16.54	0.00	0.00	1.6	0.405E+00	0.33	7.82	0.33	0.00	.20924E+03
16.90	0.00	0.00	1.6	0.404E+00	0.33	7.88	0.33	0.00	.21443E+03
17.27	0.00	0.00	1.6	0.402E+00	0.32	7.93	0.32	0.00	.21962E+03
17.63	0.00	0.00	1.6	0.401E+00	0.32	7.99	0.32	0.00	.22481E+03
17.99	0.00	0.00	1.6	0.400E+00	0.32	8.04	0.32	0.00	.23000E+03
18.36	0.00	0.00	1.6	0.398E+00	0.32	8.09	0.32	0.00	.23519E+03
18.72	0.00	0.00	1.6	0.397E+00	0.32	8.15	0.32	0.00	.24038E+03
19.08	0.00	0.00	1.6	0.396E+00	0.32	8.20	0.32	0.00	.24557E+03
19.45	0.00	0.00	1.6	0.395E+00	0.32	8.25	0.32	0.00	.25076E+03
19.81	0.00	0.00	1.6	0.394E+00	0.32	8.30	0.32	0.00	.25595E+03
20.17	0.00	0.00	1.6	0.392E+00	0.31	8.35	0.31	0.00	.26114E+03
20.53	0.00	0.00	1.6	0.391E+00	0.31	8.40	0.31	0.00	.26633E+03
20.90	0.00	0.00	1.6	0.390E+00	0.31	8.45	0.31	0.00	.27152E+03
21.26	0.00	0.00	1.6	0.389E+00	0.31	8.50	0.31	0.00	.27671E+03
21.62	0.00	0.00	1.6	0.388E+00	0.31	8.55	0.31	0.00	.28190E+03
21.99	0.00	0.00	1.6	0.386E+00	0.31	8.60	0.31	0.00	.28709E+03
22.35	0.00	0.00	1.6	0.385E+00	0.31	8.65	0.31	0.00	.29228E+03
22.71	0.00	0.00	1.7	0.384E+00	0.31	8.70	0.31	0.00	.29747E+03
23.08	0.00	0.00	1.7	0.383E+00	0.31	8.75	0.31	0.00	.30266E+03
23.44	0.00	0.00	1.7	0.382E+00	0.31	8.80	0.31	0.00	.30785E+03
23.80	0.00	0.00	1.7	0.380E+00	0.31	8.85	0.31	0.00	.31304E+03
24.17	0.00	0.00	1.7	0.379E+00	0.30	8.89	0.30	0.00	.31822E+03
24.53	0.00	0.00	1.7	0.378E+00	0.30	8.94	0.30	0.00	.32341E+03
24.89	0.00	0.00	1.7	0.377E+00	0.30	8.99	0.30	0.00	.32860E+03
25.26	0.00	0.00	1.7	0.376E+00	0.30	9.04	0.30	0.00	.33379E+03
25.62	0.00	0.00	1.7	0.375E+00	0.30	9.08	0.30	0.00	.33898E+03
25.98	0.00	0.00	1.7	0.374E+00	0.30	9.13	0.30	0.00	.34417E+03
26.35	0.00	0.00	1.7	0.372E+00	0.30	9.17	0.30	0.00	.34936E+03
26.71	0.00	0.00	1.7	0.371E+00	0.30	9.22	0.30	0.00	.35455E+03
27.07	0.00	0.00	1.7	0.370E+00	0.30	9.27	0.30	0.00	.35974E+03
27.44	0.00	0.00	1.7	0.369E+00	0.30	9.31	0.30	0.00	.36493E+03
27.80	0.00	0.00	1.7	0.368E+00	0.30	9.36	0.30	0.00	.37012E+03
28.16	0.00	0.00	1.7	0.367E+00	0.30	9.40	0.30	0.00	.37531E+03
28.53	0.00	0.00	1.7	0.366E+00	0.30	9.45	0.30	0.00	.38050E+03
28.89	0.00	0.00	1.7	0.365E+00	0.30	9.49	0.30	0.00	.38569E+03
29.25	0.00	0.00	1.7	0.364E+00	0.30	9.53	0.30	0.00	.39088E+03
29.62	0.00	0.00	1.7	0.363E+00	0.29	9.58	0.29	0.00	.39607E+03
29.98	0.00	0.00	1.7	0.361E+00	0.29	9.62	0.29	0.00	.40126E+03
30.34	0.00	0.00	1.7	0.360E+00	0.29	9.67	0.29	0.00	.40645E+03
30.71	0.00	0.00	1.8	0.359E+00	0.29	9.71	0.29	0.00	.41164E+03
31.07	0.00	0.00	1.8	0.358E+00	0.29	9.75	0.29	0.00	.41683E+03
31.43	0.00	0.00	1.8	0.357E+00	0.29	9.80	0.29	0.00	.42202E+03
31.80	0.00	0.00	1.8	0.356E+00	0.29	9.84	0.29	0.00	.42721E+03
32.16	0.00	0.00	1.8	0.355E+00	0.29	9.88	0.29	0.00	.43240E+03
32.52	0.00	0.00	1.8	0.354E+00	0.29	9.92	0.29	0.00	.43759E+03
32.89	0.00	0.00	1.8	0.353E+00	0.29	9.97	0.29	0.00	.44277E+03
33.25	0.00	0.00	1.8	0.352E+00	0.29	10.01	0.29	0.00	.44796E+03
33.61	0.00	0.00	1.8	0.351E+00	0.29	10.05	0.29	0.00	.45315E+03
33.98	0.00	0.00	1.8	0.350E+00	0.29	10.09	0.29	0.00	.45834E+03
34.34	0.00	0.00	1.8	0.349E+00	0.29	10.13	0.29	0.00	.46353E+03
34.70	0.00	0.00	1.8	0.348E+00	0.29	10.17	0.29	0.00	.46872E+03
35.07	0.00	0.00	1.8	0.347E+00	0.29	10.21	0.29	0.00	.47391E+03
35.43	0.00	0.00	1.8	0.346E+00	0.29	10.26	0.29	0.00	.47910E+03
35.79	0.00	0.00	1.8	0.344E+00	0.29	10.30	0.29	0.00	.48429E+03
36.16	0.00	0.00	1.8	0.343E+00	0.29	10.34	0.29	0.00	.48948E+03
36.52	0.00	0.00	1.8	0.342E+00	0.29	10.38	0.29	0.00	.49467E+03
36.88	0.00	0.00	1.8	0.341E+00	0.29	10.42	0.29	0.00	.49986E+03
37.25	0.00	0.00	1.8	0.340E+00	0.29	10.46	0.29	0.00	.50505E+03
37.61	0.00	0.00	1.8	0.339E+00	0.29	10.50	0.29	0.00	.51024E+03
37.97	0.00	0.00	1.9	0.338E+00	0.29	10.54	0.29	0.00	.51543E+03

38.34	0.00	0.00	1.9	0.337E+00	0.28	10.58	0.28	0.00	.52062E+03
38.70	0.00	0.00	1.9	0.336E+00	0.28	10.62	0.28	0.00	.52581E+03
39.06	0.00	0.00	1.9	0.335E+00	0.28	10.66	0.28	0.00	.53100E+03
39.42	0.00	0.00	1.9	0.334E+00	0.28	10.69	0.28	0.00	.53619E+03
39.79	0.00	0.00	1.9	0.333E+00	0.28	10.73	0.28	0.00	.54138E+03
40.15	0.00	0.00	1.9	0.332E+00	0.28	10.77	0.28	0.00	.54657E+03
40.51	0.00	0.00	1.9	0.331E+00	0.28	10.81	0.28	0.00	.55176E+03
40.88	0.00	0.00	1.9	0.330E+00	0.28	10.85	0.28	0.00	.55695E+03
41.24	0.00	0.00	1.9	0.329E+00	0.28	10.89	0.28	0.00	.56214E+03
41.60	0.00	0.00	1.9	0.328E+00	0.28	10.93	0.28	0.00	.56732E+03
41.97	0.00	0.00	1.9	0.327E+00	0.28	10.96	0.28	0.00	.57251E+03
42.33	0.00	0.00	1.9	0.326E+00	0.28	11.00	0.28	0.00	.57770E+03

Cumulative travel time = 577.7041 sec (0.16 hrs)
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD241: BUOYANT AMBIENT SPREADING

BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.529E-03 m^2/s
Horizontal diffusivity (initial value) = 0.265E-02 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
42.33	0.00	0.00	1.9	0.326E+00	0.28	11.00	0.28	0.00	.57770E+03
43.91	0.00	0.00	1.9	0.325E+00	0.28	11.00	0.28	0.00	.60023E+03
45.48	0.00	0.00	1.9	0.323E+00	0.28	11.00	0.28	0.00	.62275E+03
47.06	0.00	0.00	1.9	0.322E+00	0.28	11.00	0.28	0.00	.64528E+03
48.64	0.00	0.00	1.9	0.320E+00	0.29	11.00	0.29	0.00	.66780E+03
50.21	0.00	0.00	1.9	0.319E+00	0.29	11.00	0.29	0.00	.69032E+03
51.79	0.00	0.00	2.0	0.317E+00	0.29	11.00	0.29	0.00	.71285E+03
53.37	0.00	0.00	2.0	0.316E+00	0.29	11.00	0.29	0.00	.73537E+03
54.94	0.00	0.00	2.0	0.314E+00	0.29	11.00	0.29	0.00	.75790E+03
56.52	0.00	0.00	2.0	0.313E+00	0.29	11.00	0.29	0.00	.78042E+03
58.10	0.00	0.00	2.0	0.311E+00	0.29	11.00	0.29	0.00	.80295E+03
59.67	0.00	0.00	2.0	0.310E+00	0.29	11.00	0.29	0.00	.82547E+03
61.25	0.00	0.00	2.0	0.308E+00	0.29	11.00	0.29	0.00	.84799E+03
62.83	0.00	0.00	2.0	0.307E+00	0.29	11.00	0.29	0.00	.87052E+03
64.40	0.00	0.00	2.0	0.305E+00	0.30	11.00	0.30	0.00	.89304E+03
65.98	0.00	0.00	2.0	0.304E+00	0.30	11.00	0.30	0.00	.91557E+03
67.56	0.00	0.00	2.0	0.303E+00	0.30	11.00	0.30	0.00	.93809E+03
69.13	0.00	0.00	2.0	0.301E+00	0.30	11.00	0.30	0.00	.96061E+03
70.71	0.00	0.00	2.0	0.300E+00	0.30	11.00	0.30	0.00	.98314E+03
72.29	0.00	0.00	2.0	0.298E+00	0.30	11.00	0.30	0.00	.10057E+04
73.86	0.00	0.00	2.0	0.297E+00	0.30	11.00	0.30	0.00	.10282E+04
75.44	0.00	0.00	2.1	0.295E+00	0.30	11.00	0.30	0.00	.10507E+04
77.02	0.00	0.00	2.1	0.294E+00	0.30	11.00	0.30	0.00	.10732E+04
78.60	0.00	0.00	2.1	0.292E+00	0.31	11.00	0.31	0.00	.10958E+04
80.17	0.00	0.00	2.1	0.291E+00	0.31	11.00	0.31	0.00	.11183E+04
81.75	0.00	0.00	2.1	0.290E+00	0.31	11.00	0.31	0.00	.11408E+04
83.33	0.00	0.00	2.1	0.288E+00	0.31	11.00	0.31	0.00	.11633E+04
84.90	0.00	0.00	2.1	0.287E+00	0.31	11.00	0.31	0.00	.11859E+04
86.48	0.00	0.00	2.1	0.285E+00	0.31	11.00	0.31	0.00	.12084E+04
88.06	0.00	0.00	2.1	0.284E+00	0.31	11.00	0.31	0.00	.12309E+04
89.63	0.00	0.00	2.1	0.283E+00	0.31	11.00	0.31	0.00	.12534E+04
91.21	0.00	0.00	2.1	0.281E+00	0.31	11.00	0.31	0.00	.12760E+04
92.79	0.00	0.00	2.1	0.280E+00	0.32	11.00	0.32	0.00	.12985E+04
94.36	0.00	0.00	2.1	0.278E+00	0.32	11.00	0.32	0.00	.13210E+04
95.94	0.00	0.00	2.2	0.277E+00	0.32	11.00	0.32	0.00	.13435E+04
97.52	0.00	0.00	2.2	0.276E+00	0.32	11.00	0.32	0.00	.13660E+04
99.09	0.00	0.00	2.2	0.274E+00	0.32	11.00	0.32	0.00	.13886E+04
100.67	0.00	0.00	2.2	0.273E+00	0.32	11.00	0.32	0.00	.14111E+04
102.25	0.00	0.00	2.2	0.272E+00	0.32	11.00	0.32	0.00	.14336E+04
103.82	0.00	0.00	2.2	0.270E+00	0.32	11.00	0.32	0.00	.14561E+04
105.40	0.00	0.00	2.2	0.269E+00	0.32	11.00	0.32	0.00	.14787E+04
106.98	0.00	0.00	2.2	0.268E+00	0.33	11.00	0.33	0.00	.15012E+04
108.55	0.00	0.00	2.2	0.266E+00	0.33	11.00	0.33	0.00	.15237E+04
110.13	0.00	0.00	2.2	0.265E+00	0.33	11.00	0.33	0.00	.15462E+04
111.71	0.00	0.00	2.2	0.263E+00	0.33	11.00	0.33	0.00	.15688E+04
113.28	0.00	0.00	2.2	0.262E+00	0.33	11.00	0.33	0.00	.15913E+04
114.86	0.00	0.00	2.3	0.261E+00	0.33	11.00	0.33	0.00	.16138E+04
116.44	0.00	0.00	2.3	0.259E+00	0.33	11.00	0.33	0.00	.16363E+04
118.01	0.00	0.00	2.3	0.258E+00	0.33	11.00	0.33	0.00	.16589E+04
119.59	0.00	0.00	2.3	0.257E+00	0.34	11.00	0.34	0.00	.16814E+04
121.17	0.00	0.00	2.3	0.255E+00	0.34	11.00	0.34	0.00	.17039E+04
122.74	0.00	0.00	2.3	0.254E+00	0.34	11.00	0.34	0.00	.17264E+04
124.32	0.00	0.00	2.3	0.253E+00	0.34	11.00	0.34	0.00	.17490E+04

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    125.90     0.00    0.00     2.3 0.252E+00   0.34    11.00    0.34    0.00   .17715E+04
    127.47     0.00    0.00     2.3 0.250E+00   0.34    11.00    0.34    0.00   .17940E+04
    129.05     0.00    0.00     2.3 0.249E+00   0.34    11.00    0.34    0.00   .18165E+04
    130.63     0.00    0.00     2.3 0.248E+00   0.35    11.00    0.35    0.00   .18391E+04
    132.20     0.00    0.00     2.4 0.246E+00   0.35    11.00    0.35    0.00   .18616E+04
    133.78     0.00    0.00     2.4 0.245E+00   0.35    11.00    0.35    0.00   .18841E+04
    135.36     0.00    0.00     2.4 0.244E+00   0.35    11.00    0.35    0.00   .19066E+04
    136.93     0.00    0.00     2.4 0.243E+00   0.35    11.00    0.35    0.00   .19292E+04
    138.51     0.00    0.00     2.4 0.241E+00   0.35    11.00    0.35    0.00   .19517E+04
    140.09     0.00    0.00     2.4 0.240E+00   0.35    11.00    0.35    0.00   .19742E+04
    141.66     0.00    0.00     2.4 0.239E+00   0.36    11.00    0.36    0.00   .19967E+04
    143.24     0.00    0.00     2.4 0.237E+00   0.36    11.00    0.36    0.00   .20192E+04
    144.82     0.00    0.00     2.4 0.236E+00   0.36    11.00    0.36    0.00   .20418E+04
    146.39     0.00    0.00     2.4 0.235E+00   0.36    11.00    0.36    0.00   .20643E+04
    147.97     0.00    0.00     2.4 0.234E+00   0.36    11.00    0.36    0.00   .20868E+04
    149.55     0.00    0.00     2.5 0.232E+00   0.36    11.00    0.36    0.00   .21093E+04
    151.12     0.00    0.00     2.5 0.231E+00   0.36    11.00    0.36    0.00   .21319E+04
    152.70     0.00    0.00     2.5 0.230E+00   0.37    11.00    0.37    0.00   .21544E+04
    154.28     0.00    0.00     2.5 0.229E+00   0.37    11.00    0.37    0.00   .21769E+04
    155.85     0.00    0.00     2.5 0.227E+00   0.37    11.00    0.37    0.00   .21994E+04
    157.43     0.00    0.00     2.5 0.226E+00   0.37    11.00    0.37    0.00   .22220E+04
    159.01     0.00    0.00     2.5 0.225E+00   0.37    11.00    0.37    0.00   .22445E+04
    160.58     0.00    0.00     2.5 0.224E+00   0.37    11.00    0.37    0.00   .22670E+04
    162.16     0.00    0.00     2.5 0.223E+00   0.37    11.00    0.37    0.00   .22895E+04
    163.74     0.00    0.00     2.5 0.221E+00   0.38    11.00    0.38    0.00   .23121E+04
    165.31     0.00    0.00     2.6 0.220E+00   0.38    11.00    0.38    0.00   .23346E+04
    166.89     0.00    0.00     2.6 0.219E+00   0.38    11.00    0.38    0.00   .23571E+04
    168.47     0.00    0.00     2.6 0.218E+00   0.38    11.00    0.38    0.00   .23796E+04
    170.04     0.00    0.00     2.6 0.217E+00   0.38    11.00    0.38    0.00   .24022E+04
    171.62     0.00    0.00     2.6 0.215E+00   0.38    11.00    0.38    0.00   .24247E+04
    173.20     0.00    0.00     2.6 0.214E+00   0.39    11.00    0.39    0.00   .24472E+04
    174.77     0.00    0.00     2.6 0.213E+00   0.39    11.00    0.39    0.00   .24697E+04
    176.35     0.00    0.00     2.6 0.212E+00   0.39    11.00    0.39    0.00   .24923E+04
    177.93     0.00    0.00     2.6 0.211E+00   0.39    11.00    0.39    0.00   .25148E+04
    179.50     0.00    0.00     2.7 0.209E+00   0.39    11.00    0.39    0.00   .25373E+04
    181.08     0.00    0.00     2.7 0.208E+00   0.39    11.00    0.39    0.00   .25598E+04
    182.66     0.00    0.00     2.7 0.207E+00   0.40    11.00    0.40    0.00   .25824E+04
    184.23     0.00    0.00     2.7 0.206E+00   0.40    11.00    0.40    0.00   .26049E+04
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.205E+00 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
    185.81     0.00    0.00     2.7 0.205E+00   0.40    11.00    0.40    0.00   .26274E+04
 Plume interacts with SURFACE.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    187.39     0.00    0.00     2.7 0.204E+00   0.40    11.00    0.40    0.00   .26499E+04
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
     NO FURTHER CHANGES with downstream direction.
    188.96     0.00    0.00     2.7 0.204E+00   0.40    11.00    0.40    0.00   .26724E+04
    190.54     0.00    0.00     2.7 0.204E+00   0.40    11.00    0.40    0.00   .26950E+04
    192.12     0.00    0.00     2.7 0.203E+00   0.40    11.00    0.40    0.00   .27175E+04
    193.69     0.00    0.00     2.7 0.203E+00   0.40    11.00    0.40    0.00   .27400E+04
    195.27     0.00    0.00     2.7 0.203E+00   0.40    11.00    0.40    0.00   .27625E+04
    196.85     0.00    0.00     2.7 0.202E+00   0.40    11.00    0.40    0.00   .27851E+04
    198.42     0.00    0.00     2.7 0.202E+00   0.40    11.00    0.40    0.00   .28076E+04
    200.00     0.00    0.00     2.7 0.202E+00   0.40    11.00    0.40    0.00   .28301E+04
 Cumulative travel time =        2830.1162 sec  (    0.79 hrs)

 Simulation limit based on maximum specified distance =    200.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX2: Multiport Diffuser Discharges       End of Prediction File
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